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Social Science and the Established Order

Eli Ginzberg
Columbia University

IN HIS ADDRESS AS RETIRING PRESIDENT of the American Association for the Advancement of Science (*Science*, January 23, pp. 77–83), Dr. James Conant saw fit to deal at length with the social sciences. It is probable that many of his confreres could find little point to his musings about the present status and future prospects of economics, sociology, or government. Did he not admit that these several disciplines suffered from an absence of standards? What better proof is required that nuclear physics and biochemistry have little or nothing in common with the social disciplines?

True, Dr. Conant was very guarded in his appraisal of contemporary social science. But, for all of his caution, his optimism was considerable. He talked with warmth about the younger men and what the future held in store for them. He felt convinced that the social sciences stood on the threshold of a new and highly productive era, similar in many respects to the position in which the natural sciences found themselves at the end of the 18th Century.

There is little point in speculating whether Dr. Conant's optimism will be justified by future performance, but there is every point in considering how the social sciences are developing in the United States and what this development implies for their present and future performance.

The belief is widespread, both among the sophisticated and the naive, that the persistence of serious social conflict is proof of the immaturity—nay, failure—of the social sciences. This belief is strengthened when one compares the significant advances that the natural scientists have made in gaining control over their materials with the unsatisfactory progress of social scientists in finding answers to the political, social, and economic conflicts of our times.

This comparison is truly invidious. It fails to appreciate that, when a chemist seeks to synthesize certain elements, he can isolate his materials, submit them to a wide range of treatment, and repeat his experiment until he has confirmed his findings. Moreover, the value of his discovery will usually be self-evident.

How different with the social investigator who studies the problem of divorce! The environment in which the phenomenon occurs is constantly changing, and he is unable to stabilize any of the elements. He can present such findings as emerge only as probabilities. The implications of his research will assuredly be differently appraised by people who hold different value schemes.

One is reminded of the story of Max Planck, the famous German physicist who, at the beginning of his university studies, was undecided whether to take up economics or physics and finally chose physics because it was the easier subject! No better proof of the soundness of Planck's view need be offered than the continuing disagreements among social scientists about method. Men who remain in conflict about the nature of their subject matter and the relevance of various approaches are men who have not yet discovered how to work with assurance.

To understand how the social sciences operate and to explore the factors which contribute or deflect from their progress, one must focus attention on the environment in which they work. Wesley Clair Mitchell once defined economics as "what economists do." What economists do depends on the kind of people economists are and the kind of life they lead.

There are many economists in the employ of business and government, but it is the academic economist who invites particular attention, for even those who go out into the world have been trained in universities. And it is the university economist who remains largely responsible for the development of the discipline.

It is surprising, yet understandable, that while universities have supported the study of every branch of knowledge, ancient and modern, natural and social, they have conspicuously neglected to study themselves. This omission has many implications, but none more significant than for the social sciences. For the social sciences are a product of universities; the men who work in the social sciences are university trained, university sponsored, university supported.

The university impinges directly on the social sciences in five distinct, yet related, areas—by the selection of the student body, by its sanctification of scientific method, by the extreme specialization of its curriculum, by the appointment and promotion of staff, and, finally, by its relations to the outside world. In each of these areas the influences exerted by the university are substantial; the combined impress of these forces is overwhelming. To appraise the social sciences without appraising the influence of the university on their development is comparable to analyz-

ing the position of contemporary labor without reference to trade unions.

Until recently, the impression was widespread that schooling in the United States was free, that he who wanted to learn and was capable of learning could gain admission either to a tax-supported institution or to a private institution which provided scholarships for the poor. In the face of the report of the President's Commission on Higher Education, this particular illusion can no longer be maintained, Students of the subject have long been aware that, although the United States was in the vanguard of the free education movement, the path that it still has to tread is almost as long and surely as difficult as the ground which it has already covered.

In pursuing this analysis of the social sciences we will concentrate on the large private universities on the eastern seaboard. They are the leaders—surely they have been the leaders—in setting standards and in training research personnel. They are doubtless losing ground to the more important institutions in the Midwest, the Far West, and the South, but theirs is still a strategic position.

It is a striking fact, though one seldom appreciated, that these large eastern universities draw their students from a remarkably limited stratum of society. How limited can best be gauged by considering the excluded groups.

The southern point of view is not represented; yet there are more than 30,000,000 whites who live in the South. Only an occasional Negro is found among the student body; yet there are 13,000,000 Negroes. Only a stray lad from a midwestern or far western farm ever finds his way to an eastern university; yet there are 25,000,000 people who live in rural areas west of the Alleghenies. In these same wide open spaces are at least another 15,000,000 urbanites whose economic and social status utterly precludes their sending their children to a large eastern university. Nor must one overlook the fact that only a rare Catholic family sends its offspring to secular universities; the Catholic population of this country approximates 25,000,000.

Who remains? About 25,000,000 who live along the Atlantic seaboard. Surely, 50% of this group is too impoverished to send their children to college, especially to one of the more expensive private institutions. In short, the large eastern universities draw their students from some 12,000,000 of the population who live in New England and the Middle Atlantic States and from a very few upper class families resident in other sections of the country.

It is possible to deal with contemporary social problems without intimate acquaintance with the value schemes of the South, the Negro, the Catholic Church, the farm community, and industrial labor—not only is it possible, but it is being done every day of the week. But at what a price! We must not lose sight of the fact that today's student body—so largely a composite of Protestant, urban, middle-class society—is tomorrow's faculty. And the occasional individual who comes out of a different environment is more likely than not to seek peace and security by assimilating himself into the "dominant group."

The point to remember is that the composition of the student body and the faculty inevitably tends to exclude serious consideration of many important value schemes in our society. Yankees are not the best interpreters of southern tradition, nor Protestants of the aims of the Catholic Church, nor bankers' sons of the aspirations of labor, nor urbanites of the values of farm life.

Not only are very important values excluded from the purview of American social scientists, but even those which worm their way in are given short shrift. There is a tradition abroad in American social science that the student must be on constant guard to be "objective." He has to concern himself with the evidence, not with the implications thereof. He must collect the facts, organize them, and present them "in a scientific and impartial manner . . . as to make the findings carry conviction to Liberal and Conservative alike." That every research investigator has an obligation to deal honestly with his materials is implicit in our adherence to the principle that "the truth will make you free."

The stress on objectivity is commendable as long as it does not become exaggerated. Objectivity is relevant in appraising how a man works, not in estimating the value of the problems on which he works. Objectivity relates to techniques, never to premises. Yet the heart of the difficulties in the social sciences is in the selection of meaningful problems. There is much knowledge that is interesting but only some knowledge that is pertinent. There are many problems which can be solved, but there are only a few that are worth solving.

The most "objective" work in the social sciences will be stillborn unless it can be related to the values that men have and the values which they seek. Mountains of facts and elegant speculations have no chance of survival unless they bear on problems of import to society. The citizen is more "objective" than the scientist, for he knows that time is short and the good, elusive. He may indulge the scholar, but he will not respect him—for how can one respect a man who has denied his responsibilities (*3*)?

So the academic tradition, in a faulty imitation of the natural sciences, has compounded the difficulties inherent in the development of a virile social science by deflecting concern away from all "value problems."

In fact, such action has inevitably helped to buttress the status quo, for what escapes study escapes censure (*2*).

There has been a trend afoot these last decades which has reinforced these tendencies to deflect attention from the major problems which are charged with conflict in favor of the accretion of ever larger bodies of specialized and uncorrelated knowledge. The universities have grown very rapidly, an expansion that has been particularly marked in the social sciences. The vastly increased student body could not be cared for by the existing faculty. The number of instructors had to be doubled and then doubled again.

It was impossible for the universities to add mature men to their staffs. Mature men are always scarce, and their numbers were hopelessly inadequate to meet the demands of the rapidly expanding market. Borrowing a leaf from industry, the universities sought a way out by adopting an intense division of labor—in academic parlance, by specialization.

Although it was clearly impossible to find men competent in the broad field of social science or even in all phases of one of the social sciences, it was possible to train experts in one branch of one discipline. The curriculum facilitated this solution. No longer did an embryonic economist pursue studies in philosophy, history, and anthropology; instead, he was exposed to the presentation of highly specialized facts about money and banking, international trade, labor problems—as if such subjects had a reality outside the curriculum or could possibly be treated intelligently except against a broad background of the major forces at work in the world (*1*).

The intense specialization was a way out of the serious dilemma of how to care for the vastly expanded student body. But instead of viewing this approach as an unfortunate makeshift, from which escape at the earliest possible moment was desirable, specialization was not only legitimized, it was exalted. Again, the tradition of "objectivity" played an important part. Under its protecting arm "good work" came to imply a thorough and complete knowledge of one specialized branch, no matter how small a branch. The search for objectivity soon became a search for perfection. Then the specialist came into control, for he could intimidate all others. Only a rare investigator would venture to grapple with a large problem where he might easily err, either in omission or commission, when he knew that he would have to run the gamut of the specialists' criticisms.

Control by specialists was not confined to intimidation. They gained secure majorities on all the faculties. Thus, not only were incoming generations of students taught by specialists, but all additions to the teaching staff were in their hands. Before long they had a strangle hold over research. In fact, they were soon in unchallenged control of the entire field.

Self-protection is the first principle of organized groups. The specialists tended to appoint only "safe" individuals to the faculty. It was so easy to rationalize one's prejudices. The question was always raised whether the prospective appointee would "fit in." Hence, the young man who showed some particular skills in one of the specialized areas had the best chance to be chosen. Of course, he had to be socially acceptable, for he and his family would become members of the community, and, of course, he had to be emotionally balanced and mature. If he were seriously concerned about social values, he could look elsewhere. The university was a home for scholars, not reformers (*4*)!

Such was the method of handling appointments. Promotions were even more closely guarded. He who would not conform could not survive. Every deviation from the norm was carefully noted and weighed by the senior staff. One is reminded of the recent action of a leading institution which, when forced to choose between two younger men, passed one by on the score that he was "erratic." As an informed observer commented, "Sure, X is erratic—he fluctuates between 85 and 95 percent efficiency; Y, whom the university selected is steady—a steady 30 percenter!"

Efforts to control competition and keep the situation stable are typical of all well-established organizations. Universities are no different. But these efforts have major significance for the development of the social sciences. It is axiomatic that good social science must be, if not revolutionary, at least nonconforming. The currently available body of theory, facts, and techniques is inadequate to cope satisfactorily with current problems. Only the new, the different, the unconventional, hold promise. Yet the system operates to place the greatest hurdles in the path of the emergence of the new.

In other fields of endeavor, the institution in search of monopoly power is forced to struggle in the public arena; although it may succeed in its efforts, the odds are that it will be checked by those who fear the concentration of unbridled power. But universities are the sacred cows of our society. They need not prove themselves. All they need do is to keep clear of challenging the prejudices of important political groups. Most Americans consider the academic queer and incompetent, a man who confuses words with life—after all, what kind of man can he be if he earns but $5,000 or, at most, $10,000 a year? Let him teach the young, but let him keep out of affairs! This is the dominant note, but there is also an undertone. Why are the social sciences not more helpful in the solution of current issues?

The academics, with few exceptions, are willing to forego the challenge of the political arena as a price for control of the campus. They are willing to teach the young and leave the management of affairs to others. They consider themselves members of a fraternal order; they write for one another; but they have little interest in the groups outside, either in the educated man or in the masses.

So strong are their exclusionist tendencies that they look with suspicion, if not with disapproval, on such of their confreres who write so that the uninitiated can understand. They fear to expose themselves to the criticism of the world outside—an understandable fear but hardly rational in a democratic society. We cannot afford the luxury of specialization in thinking —where a small minority has the responsibility to evaluate the alternatives, and the masses are forced to follow. The solution of our problems necessitates the active participation of all major groups. In social affairs, knowledge, to be useful, must ultimately be acceptable. There is no quicker road to sterility for the social sciences than the one now being pursued in which the academics have sought to protect their entrenched position by adopting a policy of splendid isolation (*5*)!

The burden of the evidence is clear. For a variety of reasons the university environment exercises a most restrictive influence on the development of the social sciences. The fact is worth stressing that this condition is not new but has been present since the birth of the social sciences. The history of economics is particularly illuminating: Its founder, Adam Smith, jumped at the opportunity to leave academic life never to return; David Ricardo, from whom most classical theory derives, never had any university connections; Karl Marx, politically suspect, could not acquire academic status; Thorsten Veblen never managed to advance beyond the grade of assistant professor!

There is no formula, simple or complex, for the production of the genius. By definition, the genius is a sport. But social science, if it must wait on the genius for its major advances, can still profit greatly from the work of talented investigators.

Unfortunately, the university is so structured that it places major, if not insuperable, handicaps in the path of progress. By failing to admit large numbers of students from the less favored classes (in part the responsibility of our inadequate secondary school system), the university suffers a double loss. The largest part of the superior brain power of the country goes to waste; the emotional drive to seek new solutions for pressing social problems is deflected. All science and scholarship suffers from this loss of brain power, but the social sciences are the particular victims of this loss of constructive social energy. People who are content with the status quo are people who can contribute little or nothing to the progress of the social sciences. Their eyes are blind to what is wrong; their ears are deaf to the sounds of dissonance; they can therefore wax warm in their praise of the present.

Those whom it admits the university trains for technical competence, not intellectual leadership. Emphasis is placed on method and technique; the values inherent in the formulation and solution of major social problems are neither recognized nor analyzed. The student is warned that it is his responsibility as a budding scientist to eschew that which cannot be measured and tested. He is trained how to work but not on what to work—and such guidance as he may receive warns him about the dangers of dealing with contentious issues whose solution is a matter of values, not facts!

Finally, the university replenishes its teaching staffs from among those students who conform most closely to prevailing standards. The best students are those who do best what their teachers do. For the nonconformer, the innovator, the challenger, there is neither tolerance nor support (*6*).

There is no easy escape for the social sciences from the strangle hold of the universities; perhaps there is no escape at all. But if they are to escape, they must receive substantial assistance. The student body must become much more representative of the body politic. Liberal subsidization of the able student is a first prerequisite. The crippling effects of specialization must be checkmated by the establishment of an educational policy that recognizes and encourages the future social scientist to go afield and to become well versed in history, psychology, the law, and, above all, in affairs, rather than to accumulate ever larger bodies of factual information in the narrow field of his concentration. Only such a policy can contribute toward the shift of current emphasis from an excessive preoccupation with technique to a more mature comprehension of the basic forces in social change.

The wise administrator and the benevolent foundation must use their power and prestige on behalf of the imaginative interloper. The best cure for monopoly is effective competition. Much capital will have to be risked before large profits can be made, but the alternative to risk is stagnation.

If the admission policies are altered, if control is wrested from the specialists, if the younger men with nonconforming ideas are encouraged—if all these things come to pass, and only to the extent that they do come to pass—the optimism of Dr. Conant about

the future of the social sciences may have a prospect of being fulfilled.

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Obituary

Simon Flexner and Medical Discovery

The gains which enlarge the life of man soon seem to him to have existed always. So it is already with those he owes to Simon Flexner. During Flexner's lifetime a fresh age of medical endeavor came in—an age in which experiment largely took over from observation. This change did not happen as matter of course—it was achieved; and in the achievement Simon Flexner played a trenchant part.

Flexner's great good fortune was to be born into his family. His German father and Alsatian mother had not long previously come to Kentucky, and he was one of 9 enterprising and gifted children, who soon had poverty to spur them on—for their father died young. Close-knit in sympathies, they helped one another toward educations worth while. The eldest son, Jacob, in time a physician, was a pharmacist first, and Simon clerked for him, becoming a pharmacist too. Then and soon after, as a medical graduate of the University of Louisville, he examined specimens from the sick and became convinced of the worth of the laboratory for medical practice, as was no one about him; for the science of medicine was at a deep ebb throughout America. He set himself to learn pathology from the meager books available, read what French and German articles he could lay hands on, heard of the graduate course started by Welch at the Johns Hopkins Hospital, and, on a family decision underwritten with the earnings of his younger brother, Abraham, went to Baltimore to learn more. He was 27 years old. Welch was already aware of him through a correspondence about tumors.

It was by now 1890 and all was astir at the "Hopkins." New ideas and new methods were to be tried out, and this in a period when resounding discoveries were announced almost weekly from Europe. For a while Flexner went about the laboratory scarcely noticed, but he felt the intellectual rapture of the time, and his curiosity and his labors were alike prodigious. Before long he gained Welch's attention in the most telling of ways—by making a find—and within a year he was appointed fellow in pathology. Welch soon placed challenging responsibilities upon him, and he grew with the growing sciences of experimental pathology, bacteriology, and immunology. After only three years he was sent off to look into an outbreak of cerebrospinal meningitis in Maryland, and after another five he headed a commission sent to learn what diseases existed in the Philippines. Through both tasks he was prepared as if by prescience for later needs. In less than 10 years Johns Hopkins made him professor of pathological anatomy. But best of all, long before then he and Welch had entered upon a friendship of admiration and trust such as now and again shines in the history of science. Throughout their lives each turned toward the other. The bond between them proved of first moment to the advance of medicine.

In 1900 Flexner went to the University of Pennsylvania as head of the Department of Pathology. Here he was pitted against heavy routine duties, but he administered so ably that they did not balk his researches. These were continually of wider scope, for he would not limit his thought to any theme, however rewarding, but at 40 kept himself still an apprentice to knowledge. The Federal Government called on him to go to California and decide whether the plague had entered from China. He had studied the disease at first hand on his way to the Philippines and now in short order disclosed its existence in San Francisco. But this he regarded as a mere aside, going back to his researches.

Medical science had meanwhile been coming into its own: after nearly 200 years of metaphysics the "experimental philosophy" had reasserted itself. In 1901 The Rockefeller Institute for Medical Research was founded. Though the idea for it was one man's, though it was made real through the beneficence of another, though its form was determined by physicians who were scientists as well, it yet must be deemed a folk expression. For it was what Americans wanted, as they were quick to realize; since pio-

neer days the homely "try and see" had been their habit, and of late they had begun to have exciting thoughts on what experiment might bring to pass for the betterment of life, if carried out in a large way. Research institutions had already been set going in Europe, either around outstanding men or to cope with specific ills, notably the infectious diseases; but The Rockefeller Institute had a larger aim: it was to test the scope of the experimental method as such.

Welch wrote, when accepting a place in the group planning the Institute (of which Flexner became a member), that the success of the project would depend entirely upon who directed it. Its tentative character was plain in the first modest grant of funds, all to be spent within 10 years. Flexner, when sought as Director, asked himself in the safety of his university, "Why should I?"; but he knew that he should and would. It was for this that he stood prepared. Now, as on later occasions, he showed what in most people might have been audacity; but in his case it was judgment.

The new undertaking got under way in 1904. For the time it was most adventurous, strange though this seems now. Highly accredited scientific personages believed that little would come of it, that discovery could not be conjured. In those days research was bound tight in the academic context, and even tried investigators feared giving themselves over to it as a career; they knew well what masses of failure must often be written off. To young university workers, uncertain of themselves and with their way still to make, the opportunities held forth by the Institute seemed utterly precarious. Flexner's first appointees were nearly all men so given over to research that their very devotion had made their lives difficult; they were nonconformists, strong only in the fact that they could discover, and all save one were young.

In Flexner's later words the Institute was an "attempt to add to knowledge by discovery"; only by corollary was it "to apply that knowledge to the prevention and alleviation of disease." His immediate problem was that of today—how best to find out. He had also to show, while the permanence of the Institute was still in doubt, that it could be of practical use; but this was soon done. The real problem remained. In attempting to solve it he did not play safe. He scorned second-rate themes bound to give a yield and would have within the Institute no ready-made "projects" and no committees with designated aims, not even permanent laboratories for this or that. An individualist even more bred than born, he put his faith in individuals, caring little what they did if they were finding out. During the years of his own long novitiate, within a period now perceived to have been the greatest in the history of medicine, he had watched knowledge in flood, lapping now here, now there, yet advancing always and penetrating into every compartment of science, however stout walled. As lesson, this had been enough. In his quest for discovery he so expanded the Institute's scope as time went on that imagination was needed to make plain that at some points it had any relation to medicine. This imagination was his—the more constructive because it was exceedingly factual—and with it he had that common sense which in its perfection is so very uncommon.

The prime aims of the Institute were accomplished within a few years. Flexner showed that society would be more than wise to support men solely for what they might find out, however distant this appeared from stated medical needs; and that men of the right sort could be trusted to have better ideas than others could think up for them. He showed too that native ability to do research, sometimes of even the first order, exists here, there, and yonder in the community, all unrevealed because it lacks training and a chance. The discoverers of the past whose greatness had seemed to set them apart were not really unique but peak instances. Forty years ago these facts were new and strange; now they are axioms, and progress takes off from them.

A prime early need of the Institute was for trained workers. In that day the products of high school, college, and medical school in succession emerged with little intellectual curiosity as a rule and almost no notion of how to go about gratifying it. Somewhere along the pedagogic tunnel one of man's primal urges had been done in.[1] Things are better now, yet when the desire to do brings a medical youngster into the laboratory, he still is at loose ends more often than not, as every oldster knows. The Institute undertook to teach him to handle himself. However perturbing it might be to laboratory heads and hampering to prompt advances, Flexner insisted that the striving youngster should develop problems of his own, and with them as much independence as he could profitably endure, so that he might become a scientist in his own right. Had not Dr. Welch done that? He realized that cross-pollination makes thought rich and that transplantation may keep it sturdy. Onlookers soon saw that the young men who came within his influence gained the capacity to cope with big possibilities; and as more and more of them went out from the Institute to start research elsewhere and to teach others, its quickening influence was felt throughout the land. European governments eagerly patterned new institutes after the American.

Flexner's task meant more to him than did any

[1] Walter Cannon once cited in this relation the Elephant's Child of Kipling, which got spanked whenever it asked a question.

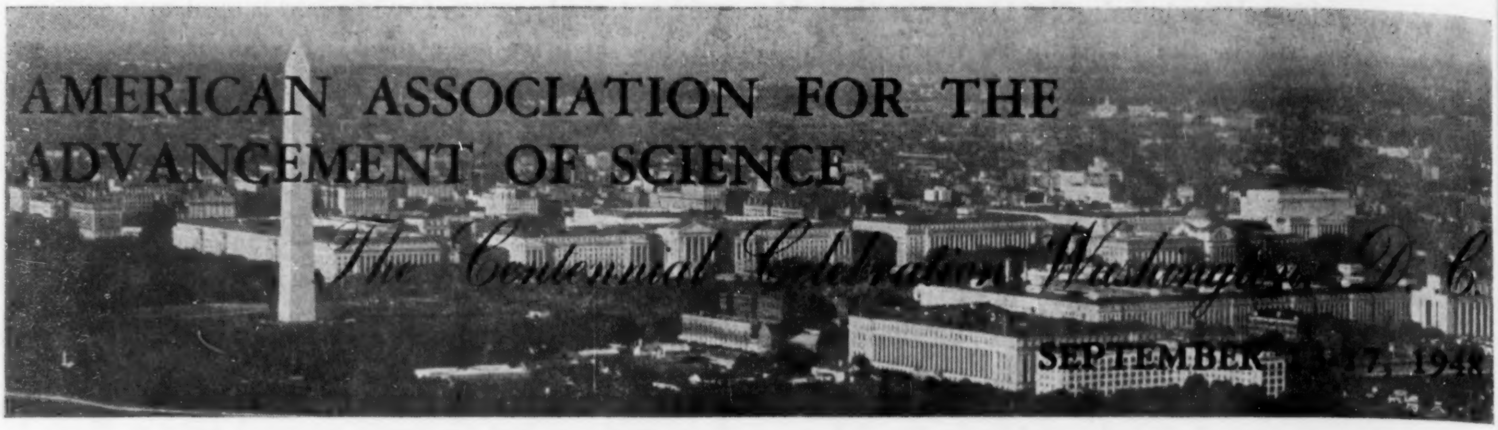
human being, himself included. Yet always he thought of discoveries within the Institute as those of individual men and discussed them in such terms, not as the yield of an organization. He was never jealous of the renown gained by others of the staff and made no pretension to intellectual leadership; yet he directed whenever there was need, had a singular awareness of what wanted doing, and with this the faculty of sharp-cut decision. Deeply believing that the biological scientist is kept strong only through contact with nature, he never delivered himself over to administration, but worked indomitably in the laboratory—always as a staff member, never as Director, being content with a single assistant.

The early 1900s reeked with preventable disease. Flexner's researches in relation to them did much to establish the Institute in the public esteem shortly after it got under way. This was especially true of his studies of cerebrospinal meningitis, which culminated in the elaboration of a serum that has saved multitudes of lives, and his disclosures concerning the virus cause of infantile paralysis, a disease newly come in epidemic form to the United States and the darker menace because almost nothing was known of its character. Completely objective about himself, he greeted his successes and the honors that crowded to him, as he did his mistakes, with equanimity. Yet he had an intense delight in youthful achievement and showed to striving young people the personal generosity that he had himself called forth in early days. He would go to great lengths to see that a difficult man got well started on leaving the Institute, sometimes adroitly helping him for years. His affections were not easily given, for life had taught him caution; but his fidelities were deep. Slight of figure, quiet spoken, he yet had a dignity so innate, so tranquil and full of meaning, that to not a few persons, as he grew older, he seemed awesome. But he understood and could feel for the other fellow. Inherently shy and reticent, humility and a covert humor tempered his power. Always he sought Mrs. Flexner's aid in his larger decisions. Her inclinations and her wisdom complemented his.

There were, of course, incessant demands upon him from without, but he would respond only to those he deemed crucial. Nevertheless, it has been said, and truly, that perhaps no man save Welch has done so much for American medicine. In part he did it through other mediums than the Institute, these making real his ideas on research, on public health, and on the education of scientists.

After his retirement in 1935 he was for a time Eastman professor at Oxford University, where the medical school, newly endowed, had to choose amongst opportunities. His last years he gave over to writing, with his younger son, and documenting for posterity, a history of the life and deeds of Welch in a time when science first came to full stature. But all these undertakings were the lesser part. He had proved that the experimental method can meet human needs if it be given its head, wide and free; and he had shown that discoverers can be discovered. These were amongst the nascent hopes of his time, and he brought them to pass.

PEYTON ROUS
The Rockefeller Institute for Medical Research



For the benefit of those planning to attend the Centennial Celebration space in these columns will from time to time be devoted to descriptions of various host institutions in and around Washington. These sketches will be accompanied by appropriate cover photographs. Last week's cover featured the David W. Taylor Model Basin; this week's shows the administration building of the National Institute of Health.

David W. Taylor Model Basin

The David W. Taylor Model Basin is the largest and the most completely equipped naval architectural research and testing establishment of its kind in the world. The theory of predicting the performance of full-scale ships from the results of model testing was conceived about two centuries ago by Emanuel Swedenborg and others in Europe, and by Benjamin Franklin in this country, but it was not developed into a practical working process until 1872, when William Froude, a celebrated civil engineer, established the first Model Basin in England.

In 1899, the U. S. Navy put into operation the U. S. Experimental Model Basin at the Washington Navy Yard. In 1936, Congress authorized the construction of the David W. Taylor Model Basin to replace and extend the work of the old Model Basin, which was no longer adequate to meet the requirements of modern types of work for the Navy and private individuals. Carderock, Maryland, was selected as the site of the new plant, since an adequate water supply was available, bedrock was at or near the surface to assure adequate permanent foundations, the plant would be readily accessible to the Navy Department, and the location would be relatively free from extraneous noise, ground vibration, smoke, and dirt. Construction was started in 1937 and the plant placed into operation in 1940.

The original conception of the establishment, as indicated by the authorizing Act, was that it should be constructed for the investigation and determination of the most suitable and desirable shapes and forms for naval vessels and for investigations of other problems of design. Thus, primarily, the establishment was designed and originally equipped to carry out experimental work on the forms of ship hulls and to estimate the power required to drive them, with a secondary interest in other features of design. This conception has been expanded far beyond the fields originally contemplated. In addition to the investigations of ships' hulls, studies are conducted on underwater forms of all types to determine the characteristics of any body which is propelled, towed, or projected on or through the water. The heading "Other Features of Design" has been expanded into the fields of structural strength, shock, vibration, underwater explosion, and related projects. Development work in the fields of electronics and acoustics is progressing to the point where they now constitute a major phase of the research at the Model Basin. In order to keep abreast of all possibilities, the Model Basin is now equipped to and does carry out wind tunnel tests on current airplane proposals and designs and ship forms.

The facilities available have been constantly improved and new ones developed. The following are now in operation: four separate model basins—a deep-water basin for testing models of large ships, a shallow-water basin for testing models of small and shallow-water vessels, with a turning basin for testing the maneuvering and steering characteristics, a high-speed basin for testing models of motor boats, seaplane hulls and pontoons, and underwater bodies, and a small model basin for testing special models and conducting unusual research investigations; two variable-pressure water tunnels for testing models of propellers to determine their characteristics and for the study of cavitation; a circulating water channel, equipped with a three-dimensional dynamometer; and a small, transparent, wall tank for the study of underwater trajectories. The principal characteristic of the circulating water channel is that the water moves past a stationary model, whereas in the model basins the models are towed through the water.

With reference to aerodynamic facilities, two subsonic wind tunnels are now in operation. In the near future these facilities will be increased by two small supersonic wind tunnels. One $2' \times 2'$ supersonic tunnel, one $7' \times 10'$ transsonic tunnel, and one large, general purpose tunnel are projected for construction.

The structural laboratory of the David Taylor Model Basin is fully equipped with instrumentation and testing machines that have been found necessary to make the assigned investigations in the past.

The Model Basin is under the management and technical control of the Bureau of Ships, Navy Department, but for purpose of military administration it is part of the Potomac River Naval Command. The director, Rear Adm. C. O. Kell, USN, is responsible for operation of the establishment and guidance of the research testing and development programs.

The Model Basin is organized into 8 principal departments: 4 scientific departments—Hydromechanics, Structural Mechanics, Aerodynamics, and Applied Physics, and 4 service departments.

The National Institute of Health

Research activities of the Public Health Service date back to 1887, when a bacteriological laboratory was set up in the Marine Hospital at the port of New York. Bacteriology was then a new science, and recognition of its value in matters pertaining to the successful administration of national quarantine and public sanitation and hygiene was immediate. Before long, the Hygienic Laboratory was moved to more suitable quarters in Washington, and in 1901 land and funds were provided to erect "a laboratory for the investigation of infectious and contagious diseases, and matters pertaining to the public health." The name was changed to the National Institute of Health in 1930, and in 1937 the Institute was moved to its present site, northwest of Washington in the adjoining Maryland countryside.

The work of the Institute developed along with the expanding program of the Public Health Service. Confronted with the practical problems of disease control, the Service depends on scientific research to discover the cause of the disease, means of spread, and, when these are known, the possible methods of prevention.

Assistant Surgeon Gen. R. E. Dyer is the director of the National Institute of Health; Medical Director Norman H. Topping is associate director.

At present there are 7 administrative divisions in the Institute:

(1) National Cancer Institute (engaged in cancer research, control activities, and the allotting of grants-in-aid);

(2) Experimental Biology and Medicine Institute (includes the Division of Physiology, Pathology Laboratory, and the Chemistry Laboratory);

(3) Division of Infectious Diseases (maintains, in addition, a large field station at Hamilton, Montana—the Rocky Mountain Laboratory);

(4) Division of Tropical Diseases (also operates a number of field units);

(5) Laboratory of Physical Biology;

(6) Biologics Control Laboratory; and

(7) Division of Research Grants and Fellowships.

In the near future, present facilities will be augmented by a 500-bed Clinical Center. Major emphasis will be placed on the study of cancer, heart disease, and mental disease.

Studies now under way at the Institute include: (1) tissue culture studies on normal and malignant cells, experimental production of tumors, and carcinogenesis induced by radiation; (2) chemotherapy of tuberculosis, surgical and burn shock, dental caries, dietary deficiency diseases, cardiovascular disease, and the aging processes; (3) the cause, epidemiology, and prevention of rickettsial diseases, the common cold, and other communicable diseases; (4) development of methods for immunization and diagnosis of malaria, clinical evaluation of antimalarial drugs, and improvement of diagnostic procedures for parasitic diseases; (5) research in the fields of biological chemistry and physics, including high- and low-energy radiation biology, molecular biophysical studies, and cellular metabolism; (6) maintenance of standards of safety, purity, and potency of biologic products.

The many scientific achievements at the Institute include: the first bacteriological diagnosis of cholera in the Western Hemisphere; pioneer work on anaphylaxis; the discovery that pellagra is a deficiency disease; studies that contributed all of our knowledge of tularemia; the discovery that typhus fever is transmitted by rat fleas as well as body lice; the isolation of the causative virus of epidemic encephalitis; the discovery of the virus of a new disease, lymphocytic choriomeningitis; the development of vaccine to be used against Rocky Mountain spotted fever; the discovery of a disease entity, ariboflavinosis; the development of hyperimmune rabbit serum for treatment of spotted fever; the discovery of curative action of physiological salt solution administered by mouth in shock produced experimentally; the first transformation in test tube of normal mammalian cells into cancer cells; the discovery of the virus of a new disease of the atypical pneumonia group; the discovery of a new clinical entity, rickettsialpox; and the isolation of an agent of the common cold.

Symposium on Natural Resources

The Symposium on Natural Resources will deal, in a broad and diversified manner, with man's relationship to the useful materials in his environment. The aim of the contributions will be to clarify thinking by the scientific and general public on the principles involved in a wise utilization of such resources. At the present time the difference between the renewable or cyclical and the nonrenewable or noncyclical resources of the earth is inadequately appreciated. The basis of any sound permanent economy must lie in ensuring that the renewable resources are really used in ways that permit full cyclical restoration, and that, in so far as nonrenewable resources are vital to such an economy, adequate provisions for continual exploitation of progressively poorer sources, and of substitute materials, be made in advance of exhaustion. Such substitutions involve social and economic as well as purely technological problems. The whole material basis of human culture is involved in problems of this kind. Such problems can be discussed only in terms of a wide variety of disciplines, ranging from geochemistry and plant physiology to economics and social anthropology. Moreover, any practical consideration of the question as to whether we are making the best use of our resources inevitably involves problems of value in contemporary cultures. A particularly urgent case is involved in the extreme strain placed by modern warfare on the riches of the earth.

The contributors to the symposium will be T. S. Lovering, of the U. S. Geological Survey; Stanley A. Cain, of the Cranbrook Institute of Science; and G. E. Hutchinson, of the Osborn Zoological Laboratory, Yale University. Dr. Lovering has had extensive experience as an investigator and a teacher and has given much attention to the general aspects of mineral resources. He is a graduate of the Minnesota School of Mines and has a doctorate from the University of Minnesota. He is the author of *Minerals in world affairs*. Dr. Cain is one of the ablest of the younger botanists of the United States. He is a graduate of Butler and has his doctorate from the University of Chicago. Before being called to the Cranbrook Institute he taught at Butler, Indiana, and the University of Tennessee. He has been particularly interested in the broader aspects of plant ecology and their relationship to evolutionary and general biological problems. Prof. Hutchinson, who has given attention to these problems in connection with his work as consultant in biogeochemistry at the American Museum of Natural History, will discuss Man in the Biosphere.

Biological Societies to Meet

A number of biological societies are planning to meet in Washington, September 10–13. Arrangements for their meetings are being handled by local committees which are being coordinated by the American Institute of Biological Sciences. It is planned to have central registration at the Willard Hotel. To date the societies which have selected their residential headquarters are the Botanical Society of America (Willard and Washington Hotels), the American Society of Zoologists (Washington Hotel), the Genetics Society of America (Roger-Smith and Hay-Adams Hotels), the American Society of Plant Taxonomists (Willard Hotel), the Mycological Society of America (Raleigh Hotel), the Phycological Society of America and the Sullivant Moss Society (Hotel Harrington), and the American Society of Naturalists (Roger-Smith Hotel).

Members of the above societies are asked not to send requests for reservations to the Hotel, but directly to Mr. Clarence Arata, Greater Washington Convention Bureau, Evening Star Building, Washington, D. C., for clearance and assignment. Single rooms are limited in number. Whenever possible, it is advisable to make reservations and share a double room, as it may be necessary to use double rooms exclusively during the AAAS meeting. Early application will be of material assistance in securing the hotel accommodations desired. It is imperative that members state whether or not they are remaining for the meetings of the AAAS. Rooms will be assigned in order of receipt of reservation. No reservations received after September 1 can be honored, as the blocks of rooms will then be released to the hotels. Hotel reservation blanks are being distributed by the secretaries of the societies, together with detailed information on program and papers.

NEWS and Notes

Herbert S. Langfeld, Stuart professor of psychology emeritus at Princeton University, has recently been appointed to membership in the Pontifical Academy of Science by Pope Pius XII.

Ira L. Wiggins, professor of botany and director of the Natural History Museum at Stanford University, has been appointed professor of botany at the University of Michigan for the 1948 Summer Session.

Benedict A. Hall, assistant professor of biology at Denison University, has recently been appointed to an assistant professorship at the State Teachers College, Cortland, New York. During the summer quarter, Prof. Hall will give courses in botany at the Appalachian State Teachers College, Boone, North Carolina.

M. C. Chang, of the Worcester Foundation for Experimental Biology, will attend the International Conference on Fertilization and Parthenogenesis, sponsored by the International Union of Biological Societies, which is to be held in Milan, Italy, June 20–26. Dr. Chang will present a paper and film entitled "The Artificial Insemination of Rabbits and the Transplantation of Rabbit Eggs." The film and the investigations depicted in it have been made possible under a grant made by the Foundation of Applied Research, San Antonio, Texas, to Gregory Pincus, director of laboratories of the Worcester Foundation.

John E. Burchard, director of the Massachusetts Institute of Technology's Libraries and of the Albert Farwell Bemis Foundation, has been named dean of the Division of Humanities to succeed **Robert G. Caldwell,** who will retire on July 1. From 1940 to 1945 Prof. Burchard was on leave from the Institute while engaged in war work with the National Research Council, NDRC, OSRD, the Office of Field Service, the National Resources Planning Board, and other organizations. He is the author of *Q.E.D.-M.I.T. in World War II,* which has just been published, and is editor and co-author of a forthcoming volume in the series dealing with the history of OSRD.

William Branch Porter, chief of the Department of Medicine and professor of medicine at the Medical College of Virginia, will represent the American Medical Association, the American Board of Internal Medicine, and the Medical College of Virginia at meetings of the British Medical Association to be held June 21 through July 2 at Cambridge University. While in Cambridge Dr. and Mrs. Porter will be the house guests of Sir Lionel Whitby, president-elect and Regius professor of physics at Cambridge. Following the meetings Dr. Porter will lecture and inspect military schools in 15 of the major cities in the U. S. Zones of Germany and Austria.

A. Remington Kellogg, who for the past 7 years has been curator of Mammals at the Smithsonian Institution, has just been named director of the U. S. National Museum, the largest of the Federal bureaus administered by the Smithsonian. Dr. Kellogg, who has had many years of experience in museum work and in handling scientific research, is one of the world's leading experts on whales and whale-like animals.

Colleges and Universities

A summer expedition to southwestern Yukon Territory is being sponsored by the R. S. Peabody Foundation, Phillips Academy, Andover, Massachusetts, and by Harvard University. Work of the expedition, to be led by Hugh M. Raup and Frederick Johnson, will be conducted with funds granted by these institutions and by the Viking Fund, the American Philosophical Society, and the Arctic Institute.

Botanical, archaeological, and geological investigations of the region centering about Kluane Lake, west of Whitehorse, are planned, the archaeological work being done by Dr. Johnson, assisted by Elmer Harp, of Dartmouth College Museum; the botanical investigations, by Dr. Raup, assisted by Mrs. Raup, Karl and David Raup, and William Drury, of Harvard University; and the geological work, by Leland Horberg, of the University of Chicago.

According to Dr. Johnson, plans are based on the success of a similar collaboration in the field during a reconnaissance of the Alaska Highway in 1943, and particularly in 1944. Geological investigations will be concerned largely with the development of the topography and will include study of frost phenomena; the archaeologists will expand present knowledge of moderately ancient sites and search for both older and younger materials; while the botanists will continue the study of the post-glacial history of the vegetation which has been carried on by Dr. Raup for a number of years. It is also hoped that preliminary study of peats in the muskegs can be made. It is expected, however, that the most valuable contribution of the expedition will be the results of close collaboration on the ground where the problems of one group can be investigated in the light of knowledge gained by workers in other fields.

Five University of Oklahoma faculty members have been selected to head a newly organized Council of Social Research within the University. John H. Rohrer, associate professor of psychology, will be director and will be assisted by Cortez A. M. Ewing, professor of government; Gilbert C. Fite, assistant professor of history; Wyatt Marrs, professor of sociology; and Jim E. Reese, associate professor of economics. The purpose of the Council is to coordinate social research projects among the faculty and various departments and to work in cooperation with the University of Oklahoma Foundation in providing worthy projects.

The Departments of Botany, Geology, and Zoology at the University of Washington will add space to their present facilities with the completion of a new wing of Johnson Hall in September 1948. The Department of Botany will move its departmental office and herbarium into space on the

top floor, the remainder of this story being devoted to research and teaching in genetics. Geology adds office and laboratory space on the ground floor in addition to a special seismograph installation in a sub-basement. Zoology will devote one floor of the wing to laboratories for teaching and research in general, cellular, and comparative physiology. Another floor is especially designed for teaching and research in morphology and embryology of the vertebrates and will add departmental and private offices of three staff members, including Arthur W. Martin, recently appointed executive officer.

The Department of Geology, University of Wisconsin, has announced that L. R. Laudon, chairman of the Department of Geology, University of Kansas, George P. Woollard, geophysicist, of Princeton University and Woods Hole, Massachusetts, and Sheldon Judson, recent graduate in geomorphology at Harvard University, will join the staff beginning in September.

New appointments to the Chemistry Department, University of California at Los Angeles, include Donald J. Cram and Robert L. Pecsok, of Harvard University, and Ralph A. James and Robert L. Scott, of the University of California, Berkeley, as assistant professors, and Sherman A. Sundet, of the University of Minnesota, as instructor.

Industrial Laboratories

Schering Corporation, Bloomfield and Union, New Jersey, has announced the appointment of Slaughter W. Lee to its staff. Dr. Lee, a chemist and formerly director of research of Wallace Laboratories, has been assigned to the development of a number of new products prepared by Schering's research divisions.

Research personnel of the Pabst Brewing Company have recently moved into a new three-story brick Research Building at 11th and McKinley Streets, in Milwaukee, according to an announcement by Alexander Frieden, the company's director of research. Part of the first floor is taken up by the pilot plant, the rest being devoted to offices and the Engineering Laboratory. The remaining two floors contain laboratories and their service units. In addition to 16 laboratory units there are a number of service units, among which are a library, a conference room, a constant temperature and humidity room, and refrigerator, incubator, and stock rooms. Both research personnel and activities have increased gradually during the past year, and the new facilities will now permit the trend to continue at an accelerated pace.

A series of tours of its plants and laboratories has recently been inaugurated by Hercules Powder Company for student chemists, chemical engineers, and their professors. Included in these tours are the company's central research laboratories near Wilmington, Delaware; the Hopewell, Virginia, cellulose products and chemical cotton plants; and the naval stores plant at Brunswick, Georgia. The visits have been arranged by Emil Ott, director of research, and members of his staff with the idea of promoting better understanding between university and industrial research workers. Transportation from the universities to the plants is being provided by one of the company's Lockheed Lodestar planes. In March and April faculty members and specially selected students from the University of Illinois and Massachusetts Institute of Technology were conducted on these tours. Trips from other universities are planned for the fall.

Daniel J. Martin has been elected a vice-president of the Hughes Tool Company, Houston, Texas, and will be in charge of the research and engineering activities of the company.

Meetings and Elections

The 8th International Congress of Genetics, to be held in Stockholm, Sweden, July 7–14, will have as its president H. J. Muller, Nobel laureate of the University of Indiana, and as vice-president, H. Federley, of the University of Helsingfors, Finland. The Organizing Committee, which has been at work for several months, consists of G. Dahlberg, State Institute for Human Genetics and Race Biology, Uppsala, chairman; G. Bonnier, Animal Breeding Institute, Wiad, secretary-general; T. Caspersson, Institute for Cell Research, Stockholm; A. Müntzing, Institute of Genetics, University of Lund; and G. Turesson, Institute of Plant Systematics and Genetics, Royal Agricultural College, Uppsala. Several geneticists from the United States are planning to present papers at the Congress. Both the Genetics Society of America and the Genetical Society of Great Britain have appointed committees to assist members in traveling to the Congress. The American committee is under the chairmanship of M. Demerec, of the Department of Genetics, Carnegie Institution of Washington, Cold Spring Harbor, New York; the British, under the chairmanship of R. Race, of the Lister Institute, London. Those attending the Congress will have an opportunity to participate in two different pre-Congress excursions in South Sweden, one of which will be of interest to plant geneticists and the other to farm animal geneticists. These will last from July 1 to 5.

A new society for professional range men, pasture specialists, graziers, ranchers, and range users, called the American Society of Range Management, held its first annual meeting at Salt Lake City, January 30–31. The second annual meeting is to be at Denver in late January or early February, 1949.

The Society, which already has some 600 members representing the livestock industry, colleges and universities, Federal, State, and other agencies, was organized to foster advancement in the science and art of grazing land management, to promote and support the maximum sustained use of forage and soil resources of the Nation's grazing lands, to stimulate discussion and understanding of practical range and pasture problems and provide a medium for the exchange of ideas and facts among members and with allied workers, and to encourage professional improvement of its members. Membership is open to all those engaged in, or interested in, range or pasture management. The Society expects to publish a journal devoted to range and pasture problems, and

it is hoped that the first issue will appear during 1948.

Officers of the Society are: president, Joseph F. Pechanec, Portland, Oregon; vice-president, W. T. White, Portland; secretary-treasurer, Harold F. Heady, College Station, Texas; Council members, F. G. Renner, Washington, D. C.; George Stewart, Ogden, Utah; L. A. Stoddart, Logan, Utah; D. F. Costello, Fort Collins, Colorado; B. W. Allred, Fort Worth, Texas; and Vernon A. Young, College Station, Texas.

The Southeastern Branch of the Society of American Bacteriologists, organized in 1947 and having a membership of 90 persons from the states of Florida, Georgia, and Alabama, held its second biannual meeting at the University of Florida, Gainesville, April 16. W. R. Carroll, head of the Department of Bacteriology, University of Florida, and the Branch's retiring president, welcomed members and guests and presided at the morning session. High lights of the morning and afternoon sessions were 8 papers which presented recent findings in the field of bacteriology in the southeastern area. Toastmaster for the annual banquet, held at the White House Hotel, was Roland B. Mitchell, of the Florida State Board of Health. Biological warfare was the subject of the evening discussion.

Officers elected for 1948–49 included: W. C. Burkhart, University of Georgia, president; Mildred A. Engelbrecht, University of Alabama, vice-president; Martha J. Johnson, University of Georgia, secretary-treasurer; Ralph McBurney, Alabama Medical College, councilor; and Roland B. Mitchell, alternate councilor.

The fall meeting of the Branch will be held in Georgia.

The British Columbia Academy of Sciences, which is affiliated with the AAAS, sponsored a two-day conference at the University of British Columbia April 16 and 17, with an attendance of nearly 200. Scientific groups participating in the Conference included the B. C. Council of the Agricultural Institute of Canada, B. C. Psychological Association, Vancouver section of the Chemical Institute of Canada, B. C. group of the Canadian Phytopathological Society, Biology subgroup of the B. C. Academy, and Vancouver branch of the Royal Astronomical Society.

In addition to programs sponsored by these groups, one afternoon was devoted to a symposium entitled "Scientific Research in British Columbia as Applied to Natural Resources," in which the following participated: R. C. Palmer, whose subject was "Agricultural Research in British Columbia"; F. S. McKinnon, who discussed "Application of Scientific Research to the Practice of Forestry"; N. Carter, who discussed "Utilization of Fisheries Products With Particular Reference to Waste Products"; J. Gardner, who took up the subject of "Utilization of Wood Waste Products as a Source of Cellulose"; and D. Goard, who spoke on "Human Resources, Vocational Training in the Lower Mainland."

At the evening banquet the speaker was W. Rowan, head of the Department of Zoology, University of Alberta. His address, "Science and World Peace," was a challenge to scientists to help actively in leading the world to security.

The Eastern Sociological Society held its 18th annual meeting at Asbury Park, New Jersey, April 24–25. One session, under the chairmanship of John W. Riley, Jr., of Rutgers University, was devoted to papers on research projects; at another, on Social Aspects of International Relations, papers were presented by Forrest Linder, of the Statistical Office of UN, D. W. Oberdorfer, of the Bureau of the Budget, and Conrad Taeuber, of FAO; and a third session, on Problems of Sociological Personnel, was addressed by Elbridge Sibley, of the Social Science Research Council, Bryce Ryan, of Rutgers University, and Robert K. Merton, of Columbia University. Guest speaker at the annual dinner was Ralph Bunche, director of the Trusteeship Department of UN.

Officers elected for 1948 included: Thorsten Sellin, University of Pennsylvania, president; Meyer F. Nimkoff, Bucknell University, vice-president; and Bernhard J. Stern, Columbia University, secretary-treasurer. Seth Russell, Pennsylvania State College, was elected to the Executive Committee.

The 80th annual meeting of the Kansas Academy of Science was held at Pittsburg, April 29–May 1, under the presidency of J. C. Peterson, of Kansas State College, Manhattan. Frank C. Gates, secretary, reports that 223 persons registered in the Senior Academy and 125 in the Junior Academy. Seventy-eight papers were presented. The high light of the meeting was a symposium on "Some Recent Scientific Developments With Social Implications," which was given from the standpoint of physical science, biological science, psychology, and sociology, respectively, by J. S. Hughes, of Kansas State College, President L. D. Wooster, of Fort Hays Kansas State College, J. W. Nagge, of Kansas State Teachers College at Emporia, and Edwin R. Walker, of Oklahoma A & M College, Stillwater.

The following officers were elected for the meeting of the spring of 1949 at Manhattan: president, F. W. Albertson, Fort Hays Kansas State College, Hays; president-elect, P. G. Murphy, Kansas State Teachers College, Pittsburg; vice-president, P. S. Albright, Wichita University, Wichita; secretary, A. M. Guhl, Kansas State College, Manhattan; treasurer, S. V. Dalton, Fort Hays Kansas State College; librarian, D. J. Ameel, Kansas State College, Manhattan; additional members of the Executive Council, A. B. Leonard, University of Kansas, Lawrence, A. C. Carpenter, of Ottawa, and John C. Frye, University of Kansas; and associate editors for three-year terms, A. B. Cardwell and Mary T. Harman, both of Kansas State College, Manhattan.

The 11th Annual Field Reunion of the Friends of Pleistocene Geology was held on May 22–23 in Toronto, Ontario. According to Richard Foster Flint, about 65 geologists, geographers, and engineers were present. Hosts at the meeting were A. K. Watt, Ontario Department of Mines, D. F. Putnam, Department of Geography, University of Toronto, Roy E. Deane, Canada Geological Survey, and Walter Tovell, Department of Geology, University of Toronto. The group

visited the classic Toronto interglacial deposits in the Don Valley clay pit and the Scarborough cliffs and examined glacial features between Toronto, Lake Simcoe, and Waubashene on Georgian Bay.

The 12th Reunion will be held in May 1949 in New Jersey, where the Pensauken gravel will be examined.

The Colorado-Wyoming Academy of Science, at its May 8–9 meeting at Colorado State College of Education, Greeley, elected the following officers for 1948–49: president, Ben Cherrington, Denver University; vice-president, Robert H. Bruce, University of Wyoming; executive secretary, Hugo Rodeck, University of Colorado; and treasurer, Frank P. Goeder, Colorado State College, Fort Collins.

Papers were presented in 9 different sections. The Junior Academy held two half-day sessions.

Deaths

Arthur H. Burgess, 74, professor emeritus of clinical surgery at the University of Manchester, died in Edinburgh, Scotland, on May 6. Dr. Burgess, who was an authority on the treatment of cancer, was past president of the British Medical Association and of the Association of Surgeons of Great Britain and Ireland.

Joseph Mattiello, 48, industrial chemist, died of a heart attack at his home in Brooklyn, New York, on May 16. Dr. Mattiello was vice-president of the Hilo Varnish Corporation.

Fernando Sanford, 94, emeritus professor of physics at Stanford University, died May 21 in Palo Alto. Dr. Sanford retired from the Stanford faculty in 1919.

Olga R. Povitzky, 71, who for many years was affiliated with the New York City Department of Health as a physician and bacteriologist, died May 21 after a year's illness.

Joseph L. Schwind, 45, head of the Department of Anatomy in the College of Medicine, University of Cincinnati, died suddenly on May 21 at his home in Wyoming, Ohio.

John J. Shaw, 74, seismologist and manufacturer of seismographs, died May 23 in West Bromwich, England. His work at the West Bromwich Observatory will be carried on by his son, H. V. Shaw.

William Darrach, 72, dean emeritus of Columbia University's Medical Faculty, died May 23 in the Greenwich, Connecticut, Hospital, following a brief illness. Although he retired from the deanship in 1930, Dr. Darrach continued as professor of clinical surgery at Columbia and as consulting surgeon to Presbyterian Hospital until his death.

Geologists will be interested in a recent publication of the Colorado School of Mines entitled "Guide to the Geology of Central Colorado" (Vol. 43, No. 2, of the School's *Quarterly*), which was issued as the guidebook for the three field trips of the 33rd annual meeting of the American Association of Petroleum Geologists held in Denver in April. The publication is profusely illustrated with figures, plates, and a 24″×28″ index map of the state, showing major geologic structure and significant oil and gas information. Well-known geologists from the consulting and educational fields and from the U. S. Geological Survey have contributed authoritative articles, and in addition there are discussions of the areas in which the field trips were made. The guidebook, which may be obtained from the Department of Publications, Colorado School of Mines, Golden, is priced at $3.00 (postpaid).

The Science-Technology Group of the Special Libraries Association has recently announced that it is developing a "union card index of technical translations" which will show the location and availability of known scientific and technical translations of articles and reports from foreign languages into English. The fields to be covered include Engineering, Materials, Aeronautics, Chemistry, Metallurgy, Communications, Petroleum, and Technology. Any organization or institution engaged in research in these fields is invited to send a record of its translations to the index as well as to request information on the availability of a needed translation. The service will not supply actual translations but will act as a clearing house to supply information on where certain translations may be obtained, and, in cases where organizations do not wish to reveal their interests through disclosure of translations in their files, it will serve as intermediary for loans. Inquiries with respect to procedure in using this free service should be addressed to Mrs. Miriam Landuyt, Research Librarian, Caterpillar Tractor Company, Peoria 8, Illinois, who is chairman of the Translation Index Service.

The National Registry of Rare Chemicals, 35 West 33rd Street, Chicago 16, Illinois, has listed the following wanted chemicals: dambonitol, pinitol, sequoytol, scyllitol, conduritol, spermidin, agmatin, inosinic acid, xanthylic acid, uridine, 3,5-diiodothyronine, meconic acid, myristicine, D-galactoascorbic acid, L-galactoascorbic acid, L-glucoascorbic acid, tantalum boride, cytosine desoxyriboside, eriocyanin, epicarin, avidin, and galactoflavin.

Make Plans for—

American Medical Association, annual session, June 21–25, Chicago, Illinois.

American Institute of Electrical Engineers, June 21–25, Mexico City, Mexico.

First International Poliomyelitis Conference, July 12–17, Waldorf-Astoria Hotel, New York City.

Conference on the Physics of Metals, July 12–18, Amsterdam, Holland, under the auspices of the Netherlands Physical Society and the Netherlands Committee of the International Union of Pure and Applied Physics.

International Congress of Zoology, July 21–27, Paris, France.

International Congress on Mental Health, August 11–21, London, England.

International Geological Congress, 18th session, August 25–September 1, London, England.

Comments and Communications

Radioactive Needles Containing Cobalt 60

As a part of the broad program entailing applications of radioisotopes in fundamental research and therapy in progress at the Ohio State University College of Medicine during the past 8 years, studies planned in July 1946, following the announcement in this journal of the availability of radioisotopes generated in the pile at Oak Ridge, were begun in October 1947 with Co^{60}. Sufficient progress has been made to warrant a preliminary report of our studies, since they indicate that the gamma radiation emitted by the isotope will prove useful in a manner similar to the present application of radium in the treatment of radiosensitive neoplasms.

Because of difficulties encountered in machining pure cobalt rondels, we are using an alloy wire composed of 45% cobalt and 55% nickel. ("Cobanic" wire was kindly furnished by the Wilbur B. Driver Company, Newark, New Jersey.) Radioautographs of needles fashioned from the wire demonstrated uniform radioactivity per unit length after they had been irradiated in the pile at Oak Ridge, and measurements made with a Geiger-Müller counter proved that the amount of radioactivity present was in proportion to the mass. Chemical separation of the components of the alloy, carried out by Harmon L. Finston, of the Department of Chemistry, The Ohio State University, showed that the radionickel generated during exposure of the needles in the pile is very slight in amount and does not contribute significantly to the total radioactivity of the needles. A needle 3 cm long, 1 mm in diameter, and weighing 0.193 gm was measured soon after irradiation and showed 2.97 milliroentgens/hr at 1 m and gamma radiation equivalent to that from 4.08 mg of radium when the gold leaf electroscope was surrounded by 1 cm of lead. (These values were determined by L. F. Curtiss at the National Bureau of Standards.) This specific activity is suitable for many purposes; if desired, it should be possible to increase it several fold simply by longer irradiation in the pile.

Animal studies support radioautographic evidence that the soft beta radiation present should be removed by filtration to minimize periacicular necrosis in applications where only the effects of the gamma radiation are desired. This can be accomplished easily by enclosing in thin, strong, and inexpensive casings of stainless steel or Monel metal.

The alloy is strongly magnetic, and we find it convenient to handle it with a small, long electromagnet (suggested by Paul C. Aebersold) instead of the forceps commonly employed in handling needles containing radium. We have found the half-value thickness of the gamma radiation in lead to be 0.41″. The emission of gamma rays having such high energy, together with the ease of handling and availability, indicate that Co^{60} should prove especially useful in telecobalt installations. The alloy is quite malleable and can easily be machined to any desired shape before it is made radioactive. Another advantage over radium is that the radioactive wire can be bent to fit lesions such as tumors in bone. In addition, there is no danger of loss by leaks or breakage.

Clinical evaluation will be undertaken soon in collaboration with Dr. Joseph L. Morton, of the Radiology Department of The Ohio State University, after completion of animal studies now in progress. A more detailed description of the radioactive alloy needles and their properties will be presented at the American Radium Society Meeting in Chicago, June 20–22.

Wm. G. Myers

Department of Medicine,
The Ohio State University

Influence of Butyl Alcohol on Shape of Snow Crystals Formed in the Laboratory

In the course of laboratory measurements on the number of ice-forming nuclei contained in various smokes, a microscope was set up in a refrigerated box for the purpose of counting snowflakes. A supercooled cloud was formed in the refrigerated box at − 20° C by the Schaefer technique (*Science*, November 15, 1946, pp. 457–459). Smoke containing silver iodide nuclei was introduced into the cloud, and the snow crystals which formed were allowed to fall on a slide, where they were examined under a microscope. The crystals thus produced were predominantly in the form of flat hexagonal plates.

Without any intentional change in the experimental setup, it was noticed that the type of snowflakes produced had changed from the hexagonal plates to hexagonal prisms having a length of the order of 5 times their diameter. It was found that hexagonal prisms were produced until the air in the box had been cleaned out by displacing it with air from the compressed air line. When this was done, the flakes formed were once more hexagonal plates. The cause for this change in the shape of the crystals was finally traced to the presence of a small amount of normal butyl alcohol vapor in the laboratory atmosphere which had resulted from accidentally spilling some of this liquid.

The modification of crystal shape caused by traces of butyl alcohol vapor was found to vary considerably with its concentration in the air in the cold chamber. When the partial pressure of the butyl alcohol was of the order of 10^{-6} atm or less, no effect was noticeable. At a partial pressure of the order of 10^{-5} atm, the long prisms were formed. At still higher partial pressures, the effect diminished, and hexagonal plates formed once more. The effect of the butyl alcohol vapor on the crystals was found to be similar whether the cloud was seeded by silver iodide smoke or by passing a piece of solid carbon dioxide through it.

The modification of habit produced in the presence of butyl alcohol is similar to the changes which have been reported in the habit of crystals grown from solutions to which various substances have been added. For example, sodium chloride, which usually crystallizes as cubes from

aqueous solution, forms octahedra if urea is added to the solution. The suggested explanation for this change of crystal habit is that adsorption on the crystal faces changes their relative rates of growth, thus modifying their shape.

It seems probable that butyl alcohol alters the shape of the snow crystals in a similar manner. Apparently, at very low concentrations of the vapor the effect on the rate of growth is small on all faces. However, as the vapor concentration is increased, a point is reached at which the rate of growth of the sides of the prisms is greatly reduced relative to the rate of growth of the prisms' ends. At higher vapor concentrations, the adsorption apparently causes less relative difference in the rates of growth of the various faces, and the effect on the shape of the crystal is less pronounced.

Isobutyl alcohol and allyl alcohol have been found to have an effect similar to butyl alcohol, and it is presumed other higher alcohols would behave in a similar fashion. Ethyl alcohol did not show the effect and, if anything, seemed to favor formation of hexagonal plates.

V. J. Schaefer of this laboratory has extended the scope of these experiments, and a report of this work will appear in the near future.

B. VONNEGUT

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The Berlin Botanic Garden

During the last war *Science* published a report that the great botanical museum of the Berlin Botanic Garden had been largely destroyed as the result of air raids in 1943. In recent letters from Dr. Joh. Mattfeld of that institution I have received information concerning the salvaging of portions of the herbarium and library that is of importance to botanists in general and to systematists in particular. Following is my translation of extracts from these letters:

Berlin-Dahlem. 11 January, 1948

For Christmas we had a great joy. Our specimens and books that we had saved from the fire, and some that later we had acquired new, had been evacuated as a measure of safety against new bombings. Then they were transported by the garrison force to an unknown destination, so that we had to assume that they had been deported. For two years this material was lost to us—we had no idea where it had gone. Now all this material has suddenly been brought back to Berlin and is freely available to us. But we cannot bring it to Dahlem immediately since Dahlem belongs in the American sector and our material lies in the Russian sector of Berlin, near the University, Unter den Linden. It is not permissible to bring articles from one sector to another. But I have not given up hope and tomorrow will make further efforts to save this material.

The material referred to was part of the most valuable that our Museum possessed. It includes the Willdenow Herbarium . . . and thousands of types which we had selected from several families, especially of the Monocotyledons and Archichlamydeae, shortly before the fire. Also the books are mostly old, priceless, illustrated works which had escaped the fire in a bank treasury.

Berlin-Dahlem. 18 March, 1948

After lengthy negotiations we have been able this week to bring over all of our material. It filled eleven trucks. The loss from damage by water is probably 5 per cent and so is bearable. We are endlessly happy that we have this valuable material, since it is indispensable for botanists of the whole world and therefore has great significance for the international relations of our Museum. Naturally the preliminary rearrangements make several difficulties because in the ruins of the Museum only a few rooms were at first made available, and because most of our cases and shelves were burned. Wood is wholly unobtainable, but at least a mason is working on the preparation of some additional rooms.

Among the material that has just been returned to us, we find parts of Bornmüller's herbarium. We had bought this private herbarium for our Museum before the war. We had moved about half of it to Dahlem at the time of the catastrophe and it was burned along with our herbarium—that is, the families up to but excluding the Umbelliferae according to the DC.-Boissier system. The second half Bornmüller had retained in Weimar, but part thereof was in boxes in our evacuation-stock cleverly deposited in a mine-tunnel. The first (part of this second half) I hauled in two trucks from Weimar to Berlin-Dahlem in 1946, along with Bornmüller's library, which we had also bought. The remainder has now been returned to us.

Prof. Bornmüller has a tragic fate for a botanist in that he is almost blind. However, in spite of his 86 years, he is still mentally amazingly clear and alert; and so much the more does it oppress him that he can carry on no more botanical work.

The news that the Willdenow Herbarium and thousands of types and many valuable reference works have been restored to the Berlin Botanic Garden will be gladly received by botanists throughout the world. It is to be hoped that the military representatives of the United States will be as helpful as possible in advancing the rehabilitation of this great botanical institution.

E. B. BABCOCK

University of California, Berkeley

Measurement of Diffusion Coefficients in Liquids by Radioactive Tracers

For the purpose of an investigation on hydrocarbon oils the writer has developed a novel method of measuring by means of radioactive tracers the diffusion coefficient in liquids. In contrast to the various existing techniques, the activity is followed by a Geiger-Müller counter *during* the diffusion process. This is made possible by using a suitable thin, highly porous structure, containing the solvent, into which the solute diffuses from the solution which is located below the porous structure. The counter tube is placed on top of the latter. If the equations involved in the diffusion and radioactive absorption process and the effect on counts of the distance of a sample from the counter are known, the observed rate of increase of counts per minute can be evaluated in terms of the diffusion constant. A diffusion test takes about 2 hrs to complete. Results on aqueous and organic solutions of uranyl nitrate have been obtained to date. A paper on this subject is in the course of preparation.

ANDREW GEMANT

The Detroit Edison Company

TECHNICAL PAPERS

Amino Acid Impairment in Casein Heated With Glucose

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In all cases of "heat damage" to amino acids in protein foods or feeds which have come to our attention, reducing sugars have been present or potentially available. We have previously demonstrated the partial inactivation of free amino acids and amino vitamins resulting from glucose-heat treatment (*1, 3*). This results, apparently, from combination of the reactive groups with aldoses, their aldehyde degradation products, or (most probably) polymers of the latter. The validity of our conclusions has been corroborated in at least two other laboratories (*2, 6*).

With increasing use of protein hydrolysates and crystalline amino acids for food and feed fortification, such glucose-heat damage to free amino acids may become important. At present, however, amino acids are consumed chiefly in combined form as proteins, and the evidence cited above does not prove that amino acids are similarly attacked in intact proteins. This phase of the problem has been investigated in the following manner:

Vitamin Test Casein (G.B.I.), free from dialyzable nitrogen, was refluxed 24 hrs in a 5% N-free glucose solution at 96.5° C. Aliquots of this glucose-heat treated sample, freed from glucose, were used for comparison with the untreated casein on an equivalent weight basis. Both untreated and treated casein were hydrolyzed by refluxing 30 hrs in 6 N HCl. For tryptophan assay, the samples were digested with pepsin, papain and Taka-diastase, and trypsin. Nine essential amino acids were determined microbiologically by the method of Stokes, *et al.* (*7*), using *Str. faecalis R*, modified by substituting sucrose for glucose in the media to prevent further inactivation (*1*).

The results, shown in Table 1, indicate that, of the 9 essential amino acids assayed, only lysine, arginine, and tryptophan were inactivated to an appreciable extent by the glucose-heat treatment. Analyzed by Student's pairing method, the data show statistically significant decreases for certain of the other amino acids. However, if the actual percentage decrease is examined, it will be noted that the decreases are of questionable significance nutritionally. The heat treatment used in these tests was purposely mild; it is quite possible that more drastic heat in the presence of an aldose would cause greater inactivation. Theoretically, lysine, arginine, tryptophan, and possibly histidine would be expected to be most susceptible to reaction with aldehydes, since these amino acids contain functional nitrogen groups unattached in polypeptide linkages.

TABLE I

AMINO ACID CONTENT OF UNTREATED AND GLUCOSE-HEAT TREATED CASEIN

Amino acid	Sampling distribution			Significance	
	Untreated $\overline{A} \pm S_A$	Treated $\overline{B} \pm S_B$	Decrease $\overline{A-B} \pm S_{\overline{A-B}}$	t	Probability
	(%)	(%)			
Lysine	5.07 ± 0.50	3.75 ± 0.55	1.322 ± 0.353	10.575	999 : 1,000
Arginine	3.30 ± 0.30	2.29 ± 0.22	1.008 ± 0.164	17.351	999 : 1,000
Tryptophan	0.95 ± 0.07	0.58 ± 0.08	0.370 ± 0.133	7.857	999 : 1,000
Histidine	3.05 ± 0.15	2.84 ± 0.03	0.210 ± 0.130	3.950	99 : 100
Methionine	2.29 ± 0.20	2.32 ± 0.10	− 0.030 ± 0.167	3.999	99 : 100
Valine	6.09 ± 0.22	6.24 ± 0.28	− 0.146 ± 0.298	1.388	77 : 100
Leucine	8.43 ± 0.10	8.20 ± 0.09	0.226 ± 0.106	6.072	999 : 1,000
Isoleucine	5.36 ± 0.31	5.05 ± 0.24	0.314 ± 0.258	3.434	99 : 100
Threonine	2.94 ± 0.08	3.12 ± 0.05	− 0.183 ± 0.108	4.149	99 : 100

We feel it is no coincidence that Riesen, *et al.* (*4*) found that the amount of each of the essential amino acids liberated by acid hydrolysis from soybean oil meal, *except lysine, arginine, and tryptophan,* was unaffected by heat treatment. Soybeans contain ample aldose to explain these results on the basis of the glucose-heat reaction we have observed. In part, at least, the inactivation of lysine in baked products, "puffed" cereals, and casein (*8*), as well as other foods, may be due to this reaction. Even pure casein contains a reducing sugar (galactose) as an integral part of the molecule (*5*).

It thus appears that heat processing of foods or feeds in the presence of reducing sugar results in partial inactivation of free amino acids, amino vitamins, and at least three essential amino acids (lysine, arginine, and tryptophan) in protein. In light of these findings, one may question the effect on nutritive value of adding commercial products containing reducing sugar (glucose,

maltose, etc.) to foods which are to be heat processed. Likewise, one may question the advisability of adding glyceraldehyde to ordinary sugar for the purpose of preventing dental caries, as has been proposed (*9*).

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Newly Discovered Outcrops of the Cannonball Formation in North Dakota[1]

Roland W. Brown and Richard W. Lemke

U. S. Geological Survey, Washington, D. C.

About 60,000,000 years ago, near the beginning of the Tertiary period, western North Dakota was inundated by the readvance of a sea or an arm of the sea that had been in existence in the same general region and to the eastward since late Cretaceous time. The 300′ of brown, sandy, fossiliferous sediments that were deposited in this sea in the vicinity of Bismarck and southwestward were first recognized as a marine unit by E. Russell Lloyd in 1912 and named the Cannonball marine member of the Lance formation in 1914 from typical exposures along the Cannonball River, southwest of Mandan. However, the discovery in 1907 by A. G. Leonard, former state geologist of North Dakota, of an oyster bed, interbedded with the lignitic strata of the Fort Union formation exposed in the bluffs of the Little Missouri River just south of Yule, North Dakota, had indicated the existence of an early Tertiary sea toward the east. This oyster bed is now regarded as evidence of a brackish-water estuary leading into the Cannonball sea.

A map showing the distribution of the Cannonball deposits and a description of the fauna contained therein were published in 1921 by T. W. Stanton (*2*), who, although recognizing a few species with Tertiary aspect, assigned the fauna to the late Cretaceous because of the large percentage of forms theretofore identified as Cretaceous. This age assignment served to continue the already warm debate concerning the Cretaceous-Tertiary boundary in the Rocky Mountains and Plains region. In 1940, S. K. Fox, Jr., and R. J. Ross, Jr. (*1*), reported that an analysis of 64 species of foraminifers from the Cannonball showed clear relationships to those of the Midway strata of the Gulf Coast and indicated Paleocene age. On this evidence the U. S. Geological Survey in 1944 formally adopted the name Cannonball formation, wit assignment to the Paleocene series.

Interest in the Cannonball formation continues becau its outcrops provide readily identifiable stratigraphi markers and because clues are sought to determin whether the Cannonball sea had Arctic or Gulf of Mexic connections. As no marine fauna of Cannonball tim has ever been found in the Canadian region toward th Arctic Ocean, the Midway aspect of the Cannonball faun for lack of competitive comparison, must be regarded a one-sided evidence that the connections of the Cannon ball sea were with the Gulf of Mexico.

Eastward and northeastward from the Missouri Rive at Bismarck the bedrock strata of the Plains are for th most part concealed beneath a mantle of glacial drift, s that only in few places can satisfactory outcrops be seen but not many miles east of Bismarck late Cretaceous strat appear at the surface, showing that the Cannonball de posits, if they were ever present there, were eroded befor Wisconsin glaciation. The probability, however, tha some of the Cannonball deposits are preserved beneath th glacial cover is confirmed by the fact that in July 194 the writers came upon such outcrops on the south side o the Souris River, in road cuts on U. S. Highway 5 about 1½ miles east of Sawyer (SW¼ sec. 12, T. 153 N R. 81 W.) and about 2½ miles east of Velva (SW¼ sec 18, T. 153 N., R. 79 W.), North Dakota, respectively These localities are approximately 55 miles north of th nearest hitherto reported outcrops of the Cannonball o the Missouri River, near Washburn. The exposures, a altitudes of 1,540′ and 1,520′, respectively, may be nea the top of the Cannonball, because they are overlaid to th northwest at a slightly higher level by lignitic strat whose stratigraphic position and fossil content sugges equivalence to the Tongue River member of the For Union formation of regions to the westward.

The thinly bedded brown sands and sandy shales o the outcrops yielded the foraminifers (identified by J. A Cushman) *Dentalina gardnerae* (Plummer), *Nodosari affinis* (Reuss), *Robulus wilcoxensis* Cushman and Ponto var. *dissentia* Cushman and Todd, *Robulus* cf. *inornatu* (D'Orbigny); the mollusks (identified by J. B. Reeside Jr.) *Drepanochilus americanus* (Evans and Shumard) var *pusillus* Stanton, *Polynices* sp., *Dentalium* sp., *Nucula* sp *Nuculana* sp., *Trigonarca*? sp., "*Corbula*" *mactriformi* Meek and Hayden, *Neptunella gracilis* (Stanton *Neptunella newberryi* (Meek and Hayden), *Fasciolari* (*Mesorhytis*) *dakotensis* Stanton; the worm *Serpula* sp. the ostracodes (identified by F. M. Swain) *Cytheridea* cf *fornicata* Alexander, *C.* cf. *ruginosa* Alexander, *C.* cf *multipunctata* Alexander, *Cythereis* cf. *prestwichian* Jones, *Brachythere* cf. *interrasilis* Alexander; and shar teeth (identified by D. H. Dunkle) *Odontaspis* sp.

From these outposts of the Cannonball formation on may perhaps look hopefully toward the glaciated countr north and northeastward with the expectation that stil other outcrops or subsurface evidence may be found tha will provide further information about Cannonba paleogeography and the line of retreat of the Cannonba sea in the latter half of the Paleocene. Since that dat

[1] Published by permission of the Director, U. S. Geological Survey, Washington, D. C.

the interior of North America has not been invaded by marine waters.

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The Effects of X-Rays on the Mitotic Activity of Mouse Epidermis

Norman P. Knowlton, Jr., Louis H. Hempelmann, and Joseph G. Hoffman[1]

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With the increased interest in various types of ionizing radiation as a result of the Atomic Energy Program, there is a great need for a practical method for the quantitative evaluation of the effects of sublethal doses of such radiation. Many investigators have shown that small doses of radiation result in a temporary but marked depression of the mitotic activity of lower animal, plant, embryonal, and tumor cells. This suggests that similar studies of mitosis in mammalian tissues might lead to a relatively simple and reasonably specific method of expressing radiation damage. The usual technique of determining the mitotic index of a tissue involves the actual counting of many thousands of individual cells. Since this is extremely laborious, considerable effort has been devoted to developing simpler, more expeditious methods. This preliminary report describes a simplified technique of obtaining the mitotic index of mouse skin and indicates the surprising sensitivity of the mitotic activity of mouse epithelium to the effects of X-rays.

Groups of animals (CF_1 strain white mice, 6–8 weeks of age) were exposed to specific doses of 250-KV peak voltage X-rays at the rate of 50 r/min and then autopsied at definite time intervals after exposure. Immediately after the animal had been killed by crushing the cervical spine, the ears were removed and placed in 1% acetic acid. After 16 hrs at 5° C, a homogeneous layer of epidermis two cells thick was separated from the dermis according to the technique mentioned by Hoepke (*3*) and described in detail by Cowdry (*2*). The section of epidermis was then stained with Mayer's hematoxylin and mounted on slides for study. The cells in mitosis (arbitrarily defined as the period between the breakdown of the nuclear membrane in prophase and the complete separation of the cytoplasm in telophase) in a given number of microscopic fields outlined by a Whipple disc were then counted. The number of epidermal cells in the field delimited by each Whipple disc was carefully determined for animals of the strain and age used in this study so that the final value of the mitotic index can be expressed in terms of mitoses/100,000 cells. Variation in cell numbers from field to field is statistical in nature and introduces an error of 1–2% not encountered when individual cells are counted. The much larger number of cells which can be examined practically by the field method compensates for this error by reducing the over-all statistical error. It has been shown that X-ray dosage up to 325 r does not significantly alter the number of cells per field, so this method is valid for mouse skin after radiation exposure.

The change in mitotic index of mouse epithelium produced over a range of sublethal doses of X-rays from 5 to 325 r has been studied. The graphic response of the

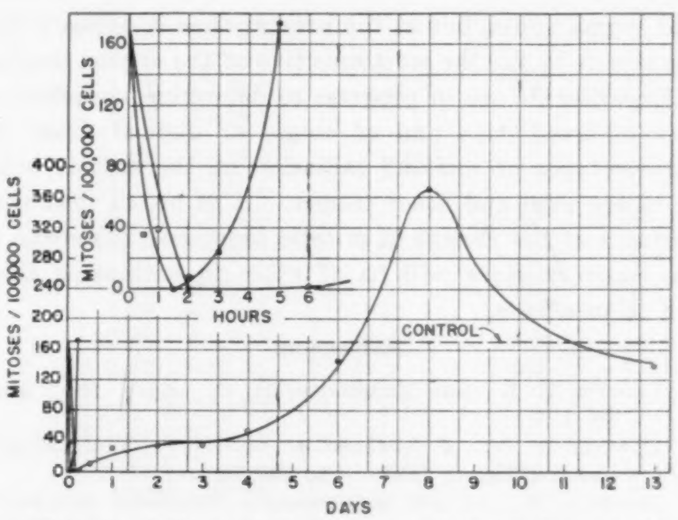

FIG. 1. Effect of X-rays on mitotic index of skin of the mouse: Broken line—Average control counts (average of 44 mice, 169/100,000 cells); Squares—35-r X-ray (5 mice/point); Circles—325-r X-ray (4 mice/point).

mitotic index in animals receiving 35 and 325 r is shown in Fig. 1. Each point on the experimental curve represents the average mitotic index obtained by examining a total of approximately 200,000 epithelial cells in 4–5 experimental animals. The diurnal variation in mitotic activity has been taken into account in the exposure groups, since there is twice as much mitotic activity during the morning as there is in the evening. This has been previously reported (*1*) and confirmed in our laboratory by means of the control animals for the above experiments.

In both of the experimental groups the minimum point of mitotic activity is less than 1 mitosis/100,000 cells. This minimum was reached in less than 2 hrs after exposure. On the other hand, the time required for the mitotic index to return to normal varies from 5 hrs at 35 r to 6 days at 325 r. An "overcompensation" phenomenon is quite evident at the 325-r dosage level, with the mitotic activity more than double that of normal on the 8th day

[1] With the technical assistance of Norma Lanter, Clare Morrison, Joan Thrap, and Julie Wellnitz. The writers gratefully acknowledge the personal help given them by Dean Robert A. Moore, Washington University, St. Louis, and Zola K. Cooper, University of Oklahoma School of Medicine, in organizing this experimental program.

[2] This document is based on work performed at Los Alamos Scientific Laboratory of the University of California under Government Contract W-7405-eng-36, and the information contained therein will appear in Division V of the National Nuclear Energy Series (Manhattan Project Technical Section) as part of the contribution of the Los Alamos Laboratory.

after irradiation. This phenomenon is being studied at the 35-r dosage level.

From the data presented above it is evident that the mitotic activity of mouse skin is extraordinarily sensitive to the effects of X-rays. Between the two dosages reported here it appears that the best index of damage is the time for the mitotic index to return to normal. Both the extent of the drop from normal and possibly the time in reaching the minimum point appear to be quite similar at these two extremes of dosage. However, the first point obtained at 325 r was at 2 hrs, and therefore the minimum point could have been reached earlier. By the use of this biological criterion of radiation effect our present program is to compare the relative destructiveness of different types and different energy-ionizing radiations.

It seems possible to postulate from the data at the dosage level of 35 r that the degree of depression of mitotic activity from normal may serve as an index of tissue damage at very low dosages. Experiments now in progress indicate that 5 r of 250-KV X-rays decreases mitotic activity to less than 25% of normal in 60–90 min.

The above work on the mitotic index in skin is being paralleled by similar studies in the jejunum, adrenals, and lymph nodes, but at the present time it appears that the skin is by far the most sensitive of the organs studied.

Experiments are in progress to determine the effect of rate of irradiation and of single or divided doses for various types of ionizing radiation on the mitotic index of mouse skin and other tissues. It is hoped that comparisons of the change in mitotic index and the shape of the recovery curve will be of value in evaluating these radiation effects.

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A Report on the Ridgway Color Standards

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Research workers have known for some time that the Ridgway Color Standards (*8*) are less useful in color description than it was originally hoped. Changes in hue, value, and chroma of the chips have resulted from aging, fading through exposure to strong light, offsetting, abrasion, and darkening through use. Moreover, there is no satisfactory way to describe those colors which occupy positions in the color space between named chips, since the spacing between the steps is quite variable. Since color records are still being made and reported in Ridgway terms, the authors believe that those biologists who are in the habit of using Ridgway, especially entomologists, mycologists, and ornithologists, would be interested in the visual differences noted among several Ridgway chips bearing the same color name.

The discrepancies were noted recently when checking the Munsell (*4*) notations for 96 colors from a set of Ridgway color chips used in Ottawa. As a result, this set was brought to Toronto and compared with two copies of Ridgway here. Notations of 12 colors were made in Baltimore from another copy. These notations are shown in Table 1. The Munsell Standards (*4*) were employed since they are convenient to use, and the work of Newhall (*5*), Nickerson (*6, 7*), and many others has demonstrated their stability, utility, and accuracy of notation. Further, the Munsell description system, like that of a recent edition of Ostwald (*1*), has the advantage of being permanently described in terms of the I. C. I. system (*2, 7*), which is internationally known and understood.

In considering the notations, some latitude must be given to inherent errors, errors of human judgment, errors produced by imperfections in viewing conditions and illumination, and errors which may possibly have arisen through the use of two sets of Munsell Standards, one in Toronto and the other in Baltimore. It is believed that the maximum error of figures shown in the table is within the limits of ±0.5 hue, ±0.25 value, and ±0.5 chroma. Though the application of these limits to the recorded notations reduces the apparent differences in some cases, it should be kept in mind that the chips for which unlike notations are given were visually different when compared directly with one another.

The copies of Ridgway checked were: two copies from the Department of Botany, University of Toronto, one (Ta) purchased in 1929 and used steadily since then, one (Tb) purchased in 1940 and used rarely and only with great care; one copy (MB) from the Munsell Color Company, Baltimore; one copy (O) from the Department of Botany, Central Experimental Farm, Ottawa, purchased in 1919 and used since then. All copies have received careful treatment and have normally been stored in the dark. All were compared with a 40-hue set of Munsell Standards with occasional reference to the constant value and chroma sheets. Part of the Munsell Standards was purchased in 1940, the remainder in 1947.

During our notation both standard and unknown chips were masked with neutral gray, value 5, illuminated at 45° by either a Spencer Daylight lamp or north skylight, and viewed normally. Both types of lighting gave comparable results except in the cases of Vinaceous Cinnamon and Vinaceous Fawn. The skylight reading is used in both. In Baltimore a 6,500° K daylight lamp was used.

The data obtained are shown in Table 1. The first column gives only the colors for which the Munsell Color Company, Baltimore, provided a notation from its copy of Ridgway; the second column, the ISCC-NBS (Inter-Society Color Council—National Bureau of Standards) (*3*) class name as derived from the Munsell notation; the third, the copy index; the fourth, the Munsell notation; the fifth, the maximum differences in terms of hue, value, and chroma steps from the Tb copy of Ridgway. The ISCC-NBS class name was added, as it describes in simple terms the colors of the Ridgway chips.

During the comparison it was noted that in most cases the differences between the Tb copy, which was in very good condition, and the others were very easily seen, even

when the differences between the Munsell notations were very slight. Two examples where there is presumably high color stability are Yellow Ocher and Vinaceous Drab. However, considerable differences were noted in Dresden Brown and Seafoam Yellow. The greatest differences found were 3.0 hue steps, 0.9 value steps, and 3.0 chroma steps.

While these differences and similarities appear to be representative of all 96 colors examined, another confusing feature—similarity of color with dissimilarity of name—was also noted. The table gives four examples which have received the ISCC-NBS color class name of Weak Orange, which also show very small differences in the Munsell notation for the Tb copy of Ridgway. These are Light Ochraceous Salmon, Light Vinaceous Cinnamon, Vinaceous Buff, and Vinaceous Cinnamon.

TABLE 1

Color names		Copies of	Munsell notation	Maximum difference		
Ridgway	Judd-Kelly	Ridgway		Hue	Value	Chroma
Chamois	Weak Yellowish Orange	Ta	2.0Y 7.6/6.0			
		Tb*	3.0Y 7.8/6.5		− 0.8	− 1.5
		MB	2.5Y 7.0/5.0		− 0.8	− 1.5
		O	2.0Y 7.5/5.8	− 1.0		
Dresden Brown	Moderate Olive	Ta	1.0Y 3.9/3.5			− 1.0
		Tb*	10.5YR 4.5/4.5			
		MB	1.0Y 4.2/3.5			− 1.0
		O	9.0YR 3.6/4.0	− 1.5	− 0.9	
Light Ochraceous Salmon	Weak Orange	Ta	6.0YR 7.2/4.5			
		Tb*	7.0YR 7.5/4.5			
		MB	6.5YR 7.2/4.5	+ 1.0	− 0.3	
		O	6.5YR 7.2/3.5			− 1.0
Light Vinaceous Cinnamon	Weak Orange	Ta	5.5YR 7.3/4.5			
		Tb*	6.0YR 7.6/5.0			
		MB	7.0YR 7.0/4.0	+ 1.0	− 0.6	− 1.0
		O	6.0YR 6.8/4.3			
Old Gold	Dark Yellow	Ta	3.0Y 5.9/5.5			
		Tb*	3.5Y 5.7/5.5			
		MB	2.5Y 5.7/5.2	− 1.0	0.0	− 0.3
		O	3.0Y 5.8/5.5			
Olive Ocher	Moderate Yellow	Ta	3.0Y 6.6/7.0	− 1.0		
		Tb*	4.0Y 7.2/6.5			
		MB	4.0Y 6.2/5.2		+ 1.0	− 1.3
		O	3.0Y 6.8/6.8	− 1.0		
Seafoam Yellow	Pale Orange	Ta	9.0Y 9.0/3.0		+ 0.2	− 1.5
		Tb*	7.0Y 8.8/4.5			
		MB	10.0Y 9.0/3.0	+ 3.0	+ 0.2	− 1.5
		O	9.0Y 9.0/3.0		+ 0.2	− 1.5
Vinaceous Buff	Weak Orange	Ta	8.0YR 7.8/3.5	+ 1.5		
		Tb*	6.5YR 7.5/4.5			
		MB	8.0YR 7.0/3.0	+ 1.5	− 0.3	− 1.5
		O	8.0YR 7.8/3.5	+ 1.5		
Vinaceous Cinnamon	Weak Orange	Ta	6.0YR 6.4/5.5†			
		Tb*	6.5YR 6.8/5.5†			
		MB	3.0YR 6.2/5.0	− 3.0	− 0.6	− 0.5
		O	6.0YR 6.5/5.5†			
Vinaceous Fawn	Weak Reddish Orange	Ta	4.0YR 6.4/3.5†			
		Tb*	5.5YR 6.8/3.5†			
		MB	2.5YR 5.9/3.0	− 3.0	− 0.9	− 0.5
		O	4.5YR 6.7/3.5†			
Yellow Ocher	Moderate Yellowish Orange	Ta	10.5YR 6.8/8.5	+ 0.5		
		Tb*	10.0YR 6.6/8.0			
		MB	10.0YR 6.0/11.0		− 0.6	+ 3.0
		O	10.0YR 6.8/9.0			
Vinaceous Drab	Weak Red Purple	Ta	10.0RP 4.7/2.0	0.0	+ 0.2	
		Tb*	10.0RP 4.5/1.8			
		MB	10.0RP 4.7/0.5		+ 0.2	− 1.3
		O	10.0RP 4.7/2.0		+ 0.2	

* Good copy.
† Made with north light.

These observations support the view that Ridgeway color chips are changing with age and use. Hence they are not desirable as permanent standards in biological work and should be replaced by a system of colors which has

been permanently described according to the requirements of the I. C. I. system.

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Flowering of the Jersey Type Sweet Potato

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Within the past 11 years certain investigators (*1–5*) have induced flowering and fruiting of many varieties, strains, and introductions of the sweet potato (*Ipomoea batatas* Lam.). In these investigations, varieties and strains of the Jersey type were a noticeable exception in that they failed to produce flowers under the conditions described. This was most unfortunate, since they generally produce a high percentage of No. 1 roots and have an attractive skin and the desired shape. Thus, the induction of flower primordia with the subsequent development of fertile pollen and ovules would be highly desirable, since the excellent characteristics of the roots of the Jersey type could be combined with disease resistance, general adaptability, and vigor of other types.

During the fall of 1947 two plants of Maryland Golden produced a small number of functional flowers in the breeding nursery of the Horticulture Research Department of Louisiana State University. Since many sweetpotato breeders are interested in the development of flowers and seed of varieties and strains of the Jersey type, a description of the conditions under which the plants flowered is presented.

The breeding nursery in which the plants were grown is equipped with vertical trellises constructed of chicken wire 6′ high and arranged in rows 8′ apart. The soil type is well drained, moderately fertile, slightly acid Lintonia silt loam. Vine cuttings were taken from plants grown in the field during the last week of October 1947, planted singly in 12″ clay pots, and trained to 1″ × 1″ × 5′ stakes. The plants were grown in a greenhouse until April 22, when they were set in the nursery rows. The greenhouse was maintained at temperatures varying from 75° to 85° F during the day and from 60° to 65° F during the night, and the plants were watered as often as necessary to permit steady vegetative growth. At the time of transplanting, the stems were 8–9′ long, the internodes were short, the leaves were normal in size and color for the variety, and the roots had thoroughly ramified through the soil in the pots. However, there were no indications of flower bud development. This was in sharp contrast to the large number of flower buds which had developed on certain seedlings which flower readily.

Transplanting operations consisted of making holes directly under the trellises 30′ apart, 18″ deep, and 12″ wide, thoroughly mixing with the soil about ½ lb of a 4–12–4 commercial fertilizer in each hole, transferring the plants from the pots to the holes, and firming the soil around the roots. In general, the plants recovered rapidly from the check in growth incident to shifting to the nursery.

Growing operations consisted of training the vines on the trellis to provide for maximum exposure of the leaves to sunlight and air, and manipulating the nitrate and water supply to promote rapid development of vines during spring and early summer and a slow growth of vines during late summer and fall. About 40 days after transplanting, $NaNO_3$ was applied, as a side dressing, at the rate of ½ lb/plant, and water was run in small irrigation furrows at biweekly intervals in May and June, at weekly intervals in July and August, and at biweekly intervals in September. Irrigation water was not applied in October. No vine trimming or stem girdling was practiced. October weather was particularly favorable for the slowing down of vine growth and the accumulation of carbohydrates, a condition associated with flower bud formation. The days were bright and warm, the nights were comparatively cool, and the rainfall was only 0.93″.

On October 28 small clusters of comparatively slender flower buds on 3–4″ slender peduncles appeared in the axes of short secondary stems on 2 of the 6 plants. The expanded corolla was about 1″ in diameter and was pale pink with a light purple throat. The stamens were slightly prostrate, and the anthers extended slightly above the level of the stigma. Pollen production was low. The superior pistil was normal in appearance and, when receptive, retained pollen on the stigma. Six cross-pollinations were made. Of these, 5 were unsuccessful, and one, between Maryland Golden and seedling L-130, was apparently successful. The ovary of the Maryland Golden, the female parent, began to grow—characteristic of successful pollinations. However, low temperatures on November 8 and 9 prevented further ovary development.

Observations at the Louisiana Experiment Station on the behavior of Maryland Golden indicate that the Jersey type requires relatively long periods for the vegetative and reproductive stages. Apparently, the vegetative stage requires conditions favorable for the development of a large number of vines; the reproductive stage, conditions favorable for the accumulation of carbohydrates for a longer period than is necessary for flowering of varieties of other types.

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IN THE LABORATORY

Rearing Houseflies and Blowflies on Dog Biscuit

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Houseflies (*Musca domestica* Linn.) are now widely reared either on the medium first described by Richardson (*3*) or on moistened crimped oats, as recommended by Eagleson (*1*). These methods have been adequately reviewed (*1, 4, 5*). Although they are satisfactory, we have developed a new method for rearing houseflies which seems to us more convenient and easier than these. This method, which utilizes dog biscuit moistened with yeast suspension as the larval rearing medium, is similar to that previously described (*2*) for the rearing of blowflies.

Adult houseflies are kept in screening cages where they are supplied with water, sugar cubes, and dried milk powder. The use of dry food minimizes spoilage such as is encountered when moist gels or liquids are used to feed the adults. Thus, servicing of the cages containing the adults requires little time.

The oviposition medium is dog biscuit which is moistened as described in the previous article (*2*), has yeast added, and is fermenting. This is placed in the cages in glass containers with straight sides, such as beakers or small museum jars. The number of eggs laid by the flies on a small amount of this fermenting material is almost unbelievable.

While it is quite simple to prepare the dog biscuit as above, we find it most convenient to keep a small mass of fermenting biscuit in a covered jar as a "seed." To this "seed" mass we add the amount of moistened dog biscuit we expect to use in the next few days and mix the two. The yeast grows rapidly, and within a day or two the whole mass is actively fermenting. When this is used for oviposition or for rearing, a small amount is left in the bottle for future "seed." We have kept a quart jar full of moistened fermenting dog biscuit for three weeks at room temperature without malodorous decomposition, and at no time did molds develop in this material. Thus, it is simple to prepare large amounts of the medium, if desired, for use over a period of time.

The rearing containers are two-quart Mason jars with two-piece lids, the solid central disks of the lids replaced with disks of 60-mesh screening. Fermenting dog biscuit is placed in one of these jars to a depth of about 2″, and to this the eggs and young larvae are added. Since the larvae do considerable wandering about in the jars, the screening caps are necessary. Cloth covers are not too satisfactory, for the larvae can escape through these.

[1] The technical assistance of Joseph Jumber in testing these methods is gratefully acknowledged.

As in the rearing of blowflies with dog biscuit, regulation of the moisture content of the medium is most important. Frankly, only experience in this can be trusted. It should be noted, however, that housefly larvae seem to tolerate wider differences in moisture content than do blowfly larvae. As the larvae develop, the medium tends to become more moist, and usually it is necessary to add some fine wood shavings or coarse sawdust. The larvae mix this with the dog biscuit and thus produce a mass of loose consistency and correct moisture content.

When the larvae are ready to pupate, further shavings or sawdust are added, either in a layer over the rearing mass or mixed with it. When the first pupae appear, the whole mass is poured into a shallow enameled pan, where it can dry out while the larvae pupate. Although the larvae will pupate in the bottles, the process is more rapid and emergence apparently better if pupation occurs in fairly dry material, away from the decomposition which sets in after the larvae have left the dog biscuit. Sorting the pupae out of the soiled shavings or sawdust for emergence seems to give the best results.

For the production of well-formed flies, one must control the density of larval population. Eight to 9 gm of dog biscuit will serve for the rearing of about 100 flies. Dog biscuit to the depth given above in a two-quart Mason jar will support easily about 2,000 larvae. With average conditions and using dog biscuit purchased in small quantities at retail for about $.18/lb, about 300 flies can be produced for $.01. Bulk purchases at wholesale prices reduce the cost still further.

This method has two advantages over those usually used: (1) no compounding of the larval medium is necessary, and (2) dog biscuit is easily and regularly available. The cost is low, and, except for the not too disagreeable odor of alcohol formed in the fermentation, there are few bad odors.

Certain difficulties have turned up in the rearing of the blowfly (*Phormia regina*), both in our laboratory and elsewhere. Some of these are clearly traceable to differences in commercial dog biscuits. Some brands do not work as well as others, and some cannot be used at all. Milk Bone Tiny Bits, manufactured by the National Biscuit Company, has given us the most consistent results.

In Minnesota, where the method was first developed for blowflies, there was no trouble with molds growing on the moistened dog biscuit. In Pennsylvania, molds have occasionally become a problem. If the larval population is inadequate and growth is not rapid, the insects do not stir the molds under. The trouble is easily overcome, however, by adding a layer of fine wood shavings or coarse sawdust, which smothers the molds and allows normal progress of the culture. Naturally, the addition of yeast to control molds was viewed as a possibility. So far this has uniformly resulted in the death of blowfly

larvae. Apparently the products of fermentation are injurious to them.

As a routine part of the rearing of blowflies we now add shavings or sawdust when the larvae reach the crawling prepupal stage, and, when the first pupae appear, the whole mass is poured from the rearing jar into a shallow enameled pan, where it dries out as pupation proceeds. The pupae are then either left in the dry material for emergence or sorted out. As in the case of houseflies, the latter results in a somewhat better emergence.

With regard to the sawdust or shavings used in the methods described, the best material we have found to date is the very coarse sawdust produced in the sawing of fresh timber with a large circular saw. Fine shavings from a wood-working shop are satisfactory, however. Ordinary fine sawdust packs too tightly, and coarse shavings are too loose. Preliminary work with cellucotton, such as is used for packaging, indicates that this material may also have value. Obviously, the moisture content of the shavings or sawdust is an important factor in their use.

In the previous paper (*2*), the question of whether blowflies reared on meat will oviposit on dog biscuit was raised. This can now be answered in the affirmative. We have obtained oviposition on moistened dog biscuit by *Phormia regina* and by other species of blowflies captured wild.

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Use of Papergrams in the Study of the Urinary Excretion of Radioactive Sulfur Compounds[1]

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In applying the paper partition chromatography technique (*1*) to the detection and separation of constituents of biological fluids, Dent (*2*, *3*) has developed a method that is convenient and particularly suitable to the study of small-volume samples. The present publication deals with the application of this technique to the study of the distribution of radioactive sulfur compounds excreted in the urine of rats fed methionine containing S^{35}.

[1] These investigations were conducted under the auspices of the Josiah Macy, Jr. Foundation, Conference on Liver Injury, and Subcommittee on Tagged Methionine, with the participation of the Schools of Medicine of the Universities of Wisconsin, California, Pennsylvania, and Emory University.

The term "papergram" is more applicable than paper chromatogram, since color is not the guide to the distribution of the components being separated.

One-dimensional papergrams were prepared in the manner described by Dent (*3*), care being taken to confine the urine spot to as small an area as possible. A total of 0.06 ml of urine may be deposited on the filter paper within a circular area 1 cm in diameter if applied in 0.01-ml aliquots and allowed to dry before the next application. The papergrams are developed overnight

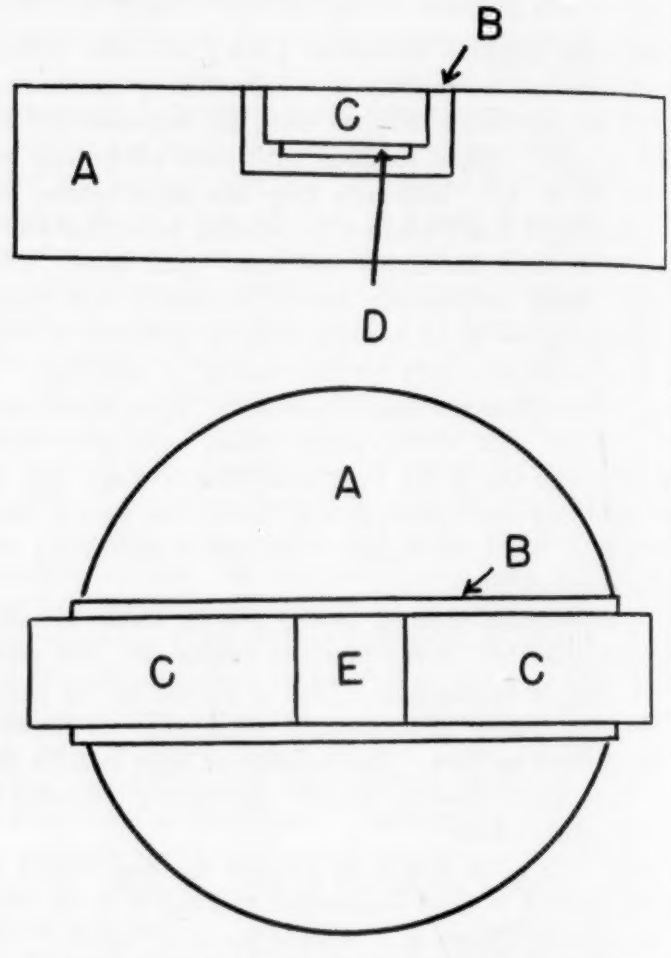

Fig. 1. Slotted base for reading of the papergram: A, lead base; B, machined brass part; C, sliding bar; D, slot; E, aperture.

The papergram is passed into the slot, D, until the first inch is under the square aperture, E, thereby exposing this section of the paper to the Geiger tube. A radioactivity count is taken, and the paper strip is then pulled into position for the reading of the next and succeeding areas.

with liquefied phenol, the phenol traveling down 11–14″ from the top of the paper. After removal of the phenol by heating, the paper is treated with some chromogenic reagent (ninhydrin) to outline the pathway followed by the urinary constituents. A strip, 1″ wide, enclosing all the colored areas and presumably all the radioactivity, is then cut from the larger piece of filter paper. The distribution of the radioactivity along the strip is determined by means of a Geiger counter, mounted on a shielded base, so constructed that the papergram may be passed beneath the window of the counter. The base is shown in Fig. 1. The radioactivity readings

taken on the first few inches (urine spot usually 2" from top of the strip) and on the portion of the paper beyond the limit of phenol development give the background reading.

The possible application of this method to the testing of the distribution of radioactive sulfur compounds of the urine was tested by rat-feeding experiments in

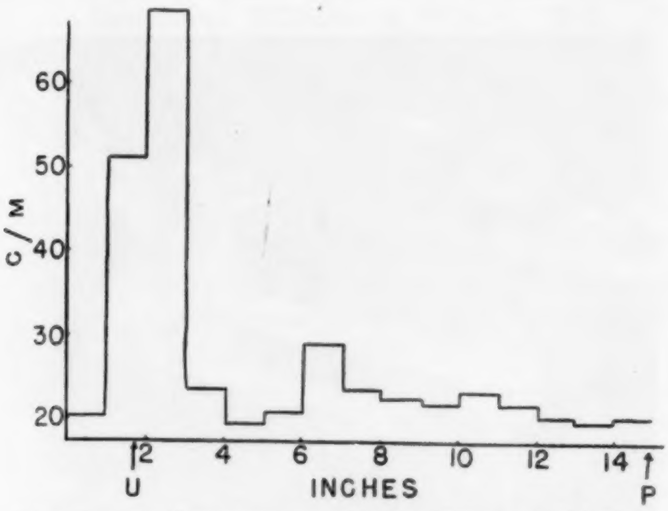

Fig. 2. Radiopapergram of urine from rat fed 5 mg (ca. 350,000 c/m) of radiomethionine: U, urine spot; P, limit of phenol development.

which radioactive methionine was administered alone and with compounds known to influence the urinary sulfur excretion. The radiopapergram of urine from an adult male white rat fed radiomethionine is presented in Fig. 2. The initial peak represents the inorganic sulfate fraction, which, being relatively phenol insoluble, moves slowly down the strip. Treatment of this urine sample with barium chloride prior to development

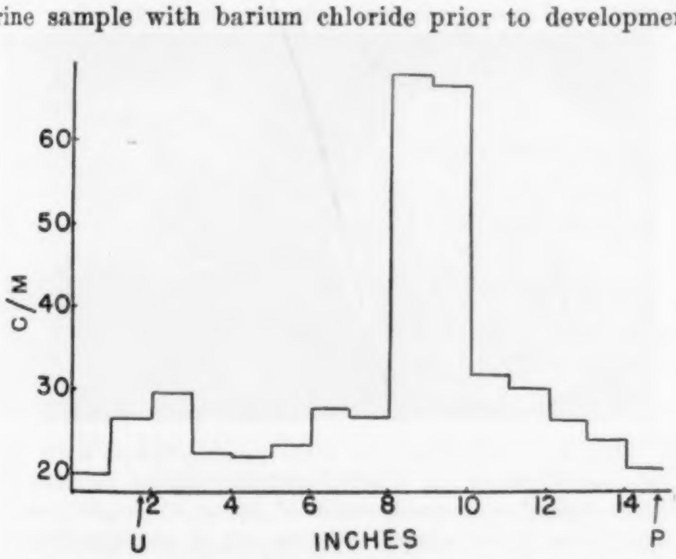

Fig. 3. Radiopapergram of urine from rat fed 5 mg (ca. 350,000 c/m) of radiomethionine followed by a subcutaneous injection of 0.15 ml of benzene: U, urine spot; P, limit of phenol development.

removes this peak. Oral administration of radiomethionine to a rat, followed by an injection of benzene, yielded the urine papergram presented in Fig. 3. The inorganic sulfate peak is not present; the radioactivity peak midway down the strip represents ethereal sulfate, the product of benzene detoxification. Hydrolysis of this urine liberates the phenolic sulfate, and, upon development of hydrolyzed urine on the papergram, the radioactivity is again found in the inorganic sulfate region.

The urine from a rat fed a suspension of bromobenzene in radiomethionine solution yielded a papergram with two radioactivity peaks. The first peak near the urine spot is that of inorganic sulfate; the second peak, at approximately three-quarters of the phenol limit, is due to mercapturic acid, the detoxication product of bromobenzene.

The radiopapergram offers promise as a useful tool in metabolism studies utilizing radioactive isotopes. With the proper refinements and standardizations, the method may be made quantitative. The monotonous chore of reading radioactivity along the paper strip may be eliminated by making the process an automatic one. This may be accomplished by synchronizing a constant speed motor, pulling the paper strip slowly beneath the Geiger counter, with a tape recorder whose pen is motivated by counting impulses coming from the scaler.

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A Simple Attachment to Increase Depth of Focus of Microscope Objectives for Photomicrography

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One of the most important considerations in photomicrography is the attainment of desired definition and perspective. Frequently it becomes necessary in this laboratory to obtain photographs of minute insect specimens of an opaque form, often *in situ*. Such photographs make necessary the use of conventional achromatic microscope objectives having magnifying powers greater than the upper limits of the longer focal lengths of the Micro Tessars. While the achromatic objectives are corrected to the highest degree for their ordinary use, marginal aberration prevents the depth of focus which is often desired. They are designed so as to sacrifice depth of focus in order to obtain the higher resolving power for which they are valued. The apochromatic objectives, because of their finer color correction and increase in usable numerical aperture, are more desirable for ordinary use than the achromatic objectives.

The necessity for *higher magnifications, with some corresponding degree of depth of focus without appreciable loss of definition and resolution*, led to the construction of a simple device by means of which satisfactory photomicrographs of small insect specimens may be made. A device was constructed to reduce sufficiently the

[1] The writer wishes to thank Dr. Laurence E. Dodd, in charge of Geometric Optics in the Physics Department of this University, for his review and criticism of this paper.

marginal aberration of the field encountered when using standard microscope objectives. This device serves the purpose of an iris diaphragm in providing a means of adjusting an otherwise permanent aperture. Reduction in aperture is effected by moving a thin metallic ribbon, perforated with holes of various sizes, across the field of vision directly under, and in gentle contact with, the microscope objective. When mounted on a mechanical stage and moved from side to side, so that the holes increase or decrease with the movement, the effect is comparable to the opening and closing of an iris diaphragm.

When the mechanical stage is used to hold the perforated strip in place, the specimen to be photographed should be directly beneath. This enables the substage condenser to be utilized to advantage. With the top element of the condenser removed, the exposed threaded ring provides a secure base upon which a small plate of ground glass may be placed. It has been found that grinding both surfaces of the plate serves to diffuse adequately strong condensed light, when transmitted central illumination becomes necessary. Diffused light may be made intense without the distracting marginal glare often encountered when the light is directly transmitted without diffusion. A small cork with the center bored out, and with a microscope-slide coverslip glued over one end, provides a satisfactory pedestal. The specimen may then be placed on the coverslip surface to receive the full benefits of the transmitted diffused lighting.

When using the substage condenser for holding the specimen, one can move vertically the entire assembly holding the specimens both above and below the surface of the microscope stage. This makes possible the manipulation of the mechanical stage holding the perforated metal strip without any interference with the specimen. Once the metal strip is locked into position, with its largest hole immediately below the objective, the latter is then carefully lowered until contact is made. The substage condenser, holding the object to be photographed, may then be elevated into approximate focus; the final focusing is completed with the fine adjustment. It then becomes a simple matter to move the device, thus bringing progressively smaller holes beneath the microscope objective until the required depth of focus is obtained.

It must be borne in mind that when extreme depth of focus is attained, a certain amount of resolving power is necessarily sacrificed. The mechanical stage should be moved into position in order to utilize the smallest aperture in the perforated metal strip consistent with adequate definition. This may not necessarily be the smallest aperture in the strip.

As the device was constructed for use in this laboratory, aluminum foil with a gauge of 0.009″ was utilized. Designed to fit the mechanical stage, the over-all length of the formed aluminum strip is 3″, with an arbitrary width of $\frac{3}{8}$″, in order to provide sufficient clearance over the object to be photographed, yet not in excess of the working distance of a 10X microscope objective.

The formed strip may be fixed to the mechanical stage or mounted on a plastic "slide" held by the mechanical stage, but with its center cut out to allow clearance for the photographed object (see Fig. 1). The holes drilled in the strip were of the following drill sizes: #'s 25, 31, 37, 41, 45, 49, 53, 57, and 60. Particular care was taken in burring the holes to prevent scratching of the microscope objective. Drilling the holes in a straight line and close to the outer edge of the strip prevents interference with frontal lighting and also provides ease of operation when selecting the proper size of aperture.

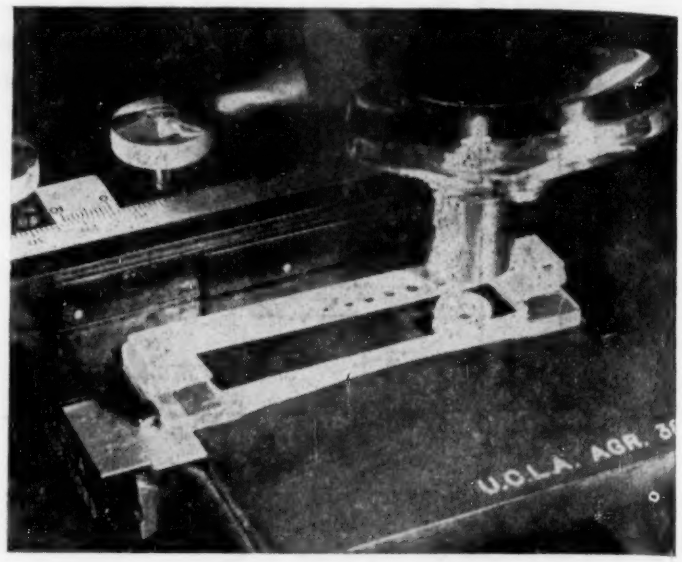

FIG. 1. Microscope attachment used to increase depth of focus in photomicrography.

With a little practice under visual observation, one soon becomes familiar with the use of this attachment. Manipulation with various heights of the substage-condenser pedestal and experimentation with various angles of lighting soon lead to easy and rapid use of the device.

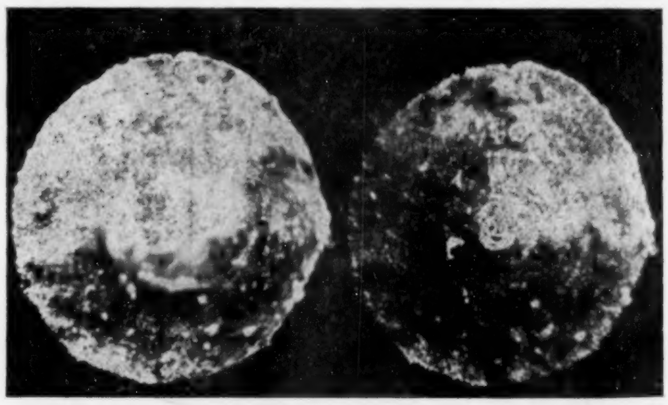

FIG. 2. California red scale photographed with top oblique lighting: A (*left*), without aid of microscope attachment to increase depth of focus; B (*right*), same specimen photographed with the aid of the attachment.

Fig. 2 shows a photomicrograph of the dorsal aspect of the California red scale, *Aonidella aurantii* (Mask.). The lighting originates simultaneously from above and from an oblique source. The optical equipment used was a 10X achromatic objective and a 5X Huygenian ocular. Fig. 2A shows the result of a compromised focal adjustment made to embrace as much of the specimen as the scope of the optical equipment would allow, while Fig. 2B shows the same specimen, using identical lighting and equipment as in A, but using the microscope attachment to increase the depth of focus.

Book Reviews

Bergey's manual of determinative bacteriology. (6th ed.) Robert S. Breed, E. G. D. Murray, A. Parker Hitchens, *et al.* Baltimore: Williams & Wilkins, 1948. Pp. xvi + 1529. $15.00.

Bergey's Manual has for many years represented the efforts of American bacteriologists to catalogue, in an orderly and systematic scheme of classification, the highly varied and variable living organisms which are the objects of their study. Never (contrary to the belief of many) sanctioned as representing the official terminology of the Society of American Bacteriologists, it has, nevertheless, enjoyed the support of that organization.

This, the 6th edition of the well-known manual, has been long in preparation and, according to the editors, represents more than the usual amount of time and effort. The active collaboration of specialists representing many diverse fields has added considerable authority to the taxonomic dicta presented. A change to double-column format and an increase in the number of pages have allowed a tremendous amount of information to be contained within one volume. No longer merely a taxonomic key, in the newer sections of the book especially, it represents a compilation of facts quite encyclopedic in scope.

Conspicuous among the innovations in this edition is the inclusion of the viruses and rickettsiae, presented as supplements to the class *Schizomycetes* or fission fungi. While properly these are not designated as members of that botanic division, their appearance reflects the difficulty of the professional bacteriologist adequately to define the subjects of his studies; a dilemma which has provoked the appearance of the science of "microbiology" to recognize the diverse biological characteristics of these organisms. It is of some interest that this is still a manual of "bacteriology"!

Although to the medical "virologist" such terms as *Formido inexorabilis* for the virus of rabies and *Phagus lacerans* for one of the streptococcus bacteriophages may seem strange, inappropriate, and somewhat difficult of assimilation, and even if one were to debate the appropriateness of inclusion of these forms in a classification of bacteria (fungi ?), the masterly treatment of the information concerning them which is gathered here evokes profound respect for those who condensed it and affords a reliable source of knowledge to the student and specialist alike. Previous taxonomic schemes for the rickettsiae have been presented; the present one, with its integration of other intracellular parasites, the *Bartonella*, and the "higher" viruses of psittacosis and related types, clearly indicates the similarities of this fascinating borderland of disease agents.

Another new and interesting addition is the source and habitat index which aids in stimulating, especially in the student, a ready appreciation of the markedly diverse activities and interrelationships of microorganisms.

As is to be expected, many taxonomic redistributions are found in this edition; in most instances sufficient explanation is given for the changes to further the teaching functions of the manual. Throughout, but more conspicuous in some parts than others, the attendant discussion of historical background, orthographic problems, and classical derivations flavors the text and makes it interesting reading as well as a systematist's key.

The collaborators and editors have prepared a volume which must be investigated by all who claim to be bacteriologists; and while it is primarily for them as specialists, it can be used with profit by all who have even a passing interest in microorganisms.

WILLIAM S. PRESTON

University of Michigan

Organizing scientific research for war: the administrative history of the Office of Scientific Research and Development. Irvin Stewart. Boston: Atlantic–Little, Brown, 1948. Pp. 358. $5.00.

This is another volume in the series entitled "Science in World War II" which constitutes the history of the Office of Scientific Research and Development. The author is former deputy director of OSRD and now president of West Virginia University. The first volume in this series, *Scientists against time*, by James Phinney Baxter, provides an over-all picture of the role played by science in the greatest and most terrible of all wars. Succeeding volumes, already issued or forthcoming, discuss, in more detail, special subjects such as New Weapons for Air Warfare, Combat Scientists, Applied Physics, and Advances in Military Medicine.

Dr. Stewart's book, however, does not recount the advances made in a special subject field. Rather, he has had the task of telling the administrative history of the Office of Scientific Research and Development.

Admittedly, this subject does not have the interest and exciting appeal which some of the other topics, already presented, carry. Nevertheless, this history of how the OSRD was organized and how it functioned, through reams of paper and miles of red tape, is despite its lack of glamour, one of the epics of the past war, and Dr. Stewart is to be commended for the excellence of his work.

The book is divided into four parts, each of which is subdivided into chapters. In Part 1, entitled "Harnessing Science," the author traces the origins of OSRD from its beginning in the NDRC through the establishment of the various committees, panels, divisions, and the Chairman's Office. Part 2 takes up the question of liaison groups and how contact was established and maintained with the various branches of the armed services and with allied governments. Part 3 includes the various operating procedures, in which Dr. Stewart discusses such vital matters as contracts for research, fiscal affairs, patent

policy priorities, security, scientific manpower, and publications. The final part tells of the demobilization of OSRD and contains a concluding chapter on "Retrospect and Prospect." Here, the author points out a fact apparently still not grasped by all who should understand it—namely, that OSRD was a temporary organization set up to do an emergency job. This it did superbly. If there is one lesson among many pointed out by this book, it is that we need a new type of organization to do in peace as well as in war all the tasks so splendidly done by OSRD and many additional jobs as well.

As this is written, the National Science Foundation Bill still languishes in Congress. The supporters of this legislation will find much food for thought in Dr. Stewart's important book.

MORRIS C. LEIKIND

Library of Congress, Washington, D. C.

Introduction to genetics and cytogenetics. Herbert Parkes Riley. New York: John Wiley; London: Chapman & Hall, 1948. Pp. xii + 596. (Illustrated.) $5.00.

We have been asked at times to recommend a book on heredity for the average reader with little knowledge of biology. This book by Dr. Riley seems to us perhaps the best we have seen for this purpose. It is designed as an introductory text for students in genetics or for the average reader who wishes to know something of the laws of heredity and serves these two purposes admirably.

The approach used by Dr. Riley is the logical one rather than a more or less historical development of genetics. The first part of the book is devoted to the physical basis of heredity, and since this phase of the work is covered adequately and written simply, the beginning student should understand it.

The following 8 chapters are devoted to segregations, linkage, crossing over, multiple alleles, and distribution of genes. The chapter on probability is concise and gives the essentials necessary to an understanding of the laws of genetics without going into a statistical treatise.

The third section of the book is concerned with the nature of gene action, while the last part deals with chromosomal irregularities. Both of these sections seem adequate for the beginning student. There is considerable material on human inheritance, including a chapter on the blood groups.

This book, which is on the whole excellent, is well illustrated, and many of the illustrations are new. There are, however, a few minor corrections that might be made if there are to be extra printings. On page 358 there is a reference to Table 19 (p. 350), where it is stated there are columns headed "x, σ, and v." Actually, in Table 19 the columns are headed "Mean, S.D., and C.V." These terms mean the same thing, but the former usage is the current one. Also, on page 327 there is an illustration showing two ears of corn segregating for the color factors C and I. Actually, C and I are allelic, and the factor is A or R not C.

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Scientific Book Register

BACHMAN, GEORGE W., and MERIAM, LEWIS. *The issue of compulsory health insurance: a study prepared at the request of Senator H. Alexander Smith, chairman of the Subcommittee on Health of the Senate Committee on Labor and Public Welfare.* Washington, D. C.: Brookings Institution, 1948. Pp. ix + 271. $2.00, paper; $4.00, cloth.

BOYNTON, HOLMES. (Ed.) *The beginnings of modern science: scientific writings of the 16th, 17th, and 18th centuries.* New York: Walter J. Black, 1948. Pp. xv + 634. (Illustrated.) $2.39.

HAGE, ROBERT E. *Jet propulsion in commercial air transportation.* Princeton, N. J.: Princeton Univ. Press, 1948. Pp. vii + 91. (Illustrated.) $1.50.

HALLIDAY, JAMES L. *Psychosocial medicine: a study of the sick society.* New York: W. W. Norton, 1948. Pp. 278. $3.50.

HAUSMAN, LEON AUGUSTUS. *Birds of prey of northeastern North America.* (Illustrated in pen and ink by Jacob Bates Abbot.) New Brunswick, N. J.: Rutgers Univ. Press, 1948. Pp. xxv + 164. $3.75.

HEWSTON, ELIZABETH M., *et al. Vitamin and mineral content of certain foods as affected by home preparation.* (U. S. Dept. of Agriculture Misc. Publ. No. 628.) Washington, D. C.: Superintendent of Documents, 1948. Pp. iv + 76. $.30.

KIMBARK, EDWARD WILSON. *Power system stability.* Vol. I: *Elements of stability calculations.* New York: John Wiley; London: Chapman & Hall, 1948. Pp. viii + 355. (Illustrated.) $6.00.

MARCH, ARTHUR. *Natur und Erkenntnis: die Welt in der Konstruktion des heutigen Physikers.* Vienna: Springer, 1948. Pp. v + 239. (Illustrated.) $4.20.

PARK, ORLANDO. *Observations on Batrisodes (Coleoptera: Pselaphidae), with particular reference to the American species east of the Rocky Mountains.* (Bull. Chicago Academy of Sciences, Vol. 8, No. 3.) Chicago: The Academy, 1947. Pp. 45–132. (Illustrated.)

SHOEMAKER, JAMES SHELDON. *Small-fruit culture: a text for instruction and reference work and a guide for field practice.* Philadelphia-Toronto: Blakiston, 1948. Pp. vii + 433. (Illustrated.) $4.00.

STORCH, OTTO. *Die Sonderstellung des Menschen in Lebensabspiel und Vererbung.* Vienna: Springer, 1948. Pp. vi + 62. 4.80 sfr.

THEILHEIMER, W. *Synthetische Methoden der organischen Chemie.* (Vo. II.) Basel, Switzerland: S. Karger, 1948. Pp. viii + 309. 35sfr.

TROMP, S. W. *The religion of the modern scientist (neomaterialism).* Leiden: Sijthoff, 1947. Pp. xxiv + 480. (Illustrated.) 15, 50 hfl.

ZELUFF, VIN, and MARKUS, JOHN. *What electronics does.* New York-Toronto-London: McGraw-Hill, 1948. Pp. ix + 306. (Illustrated.) $3.00.